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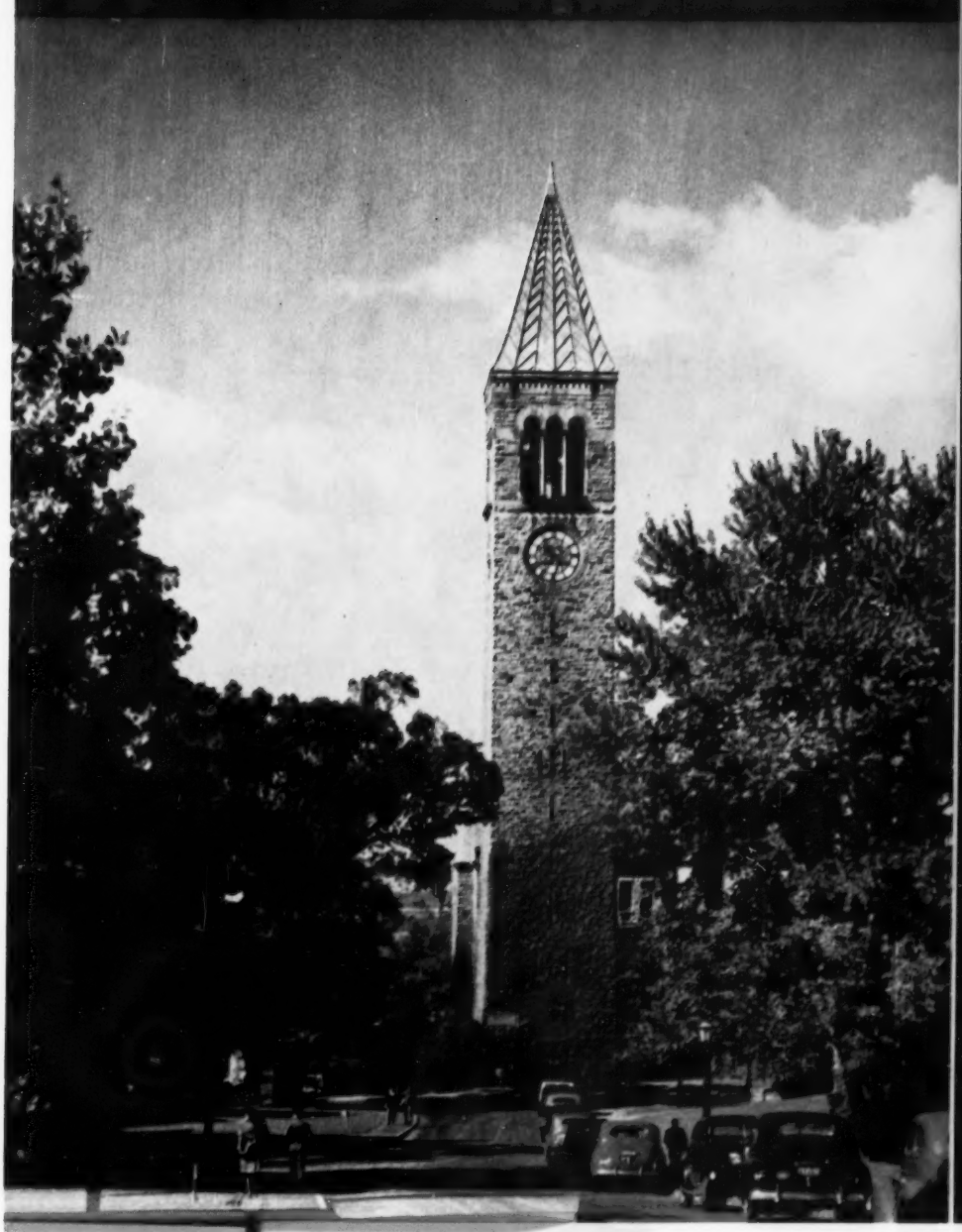
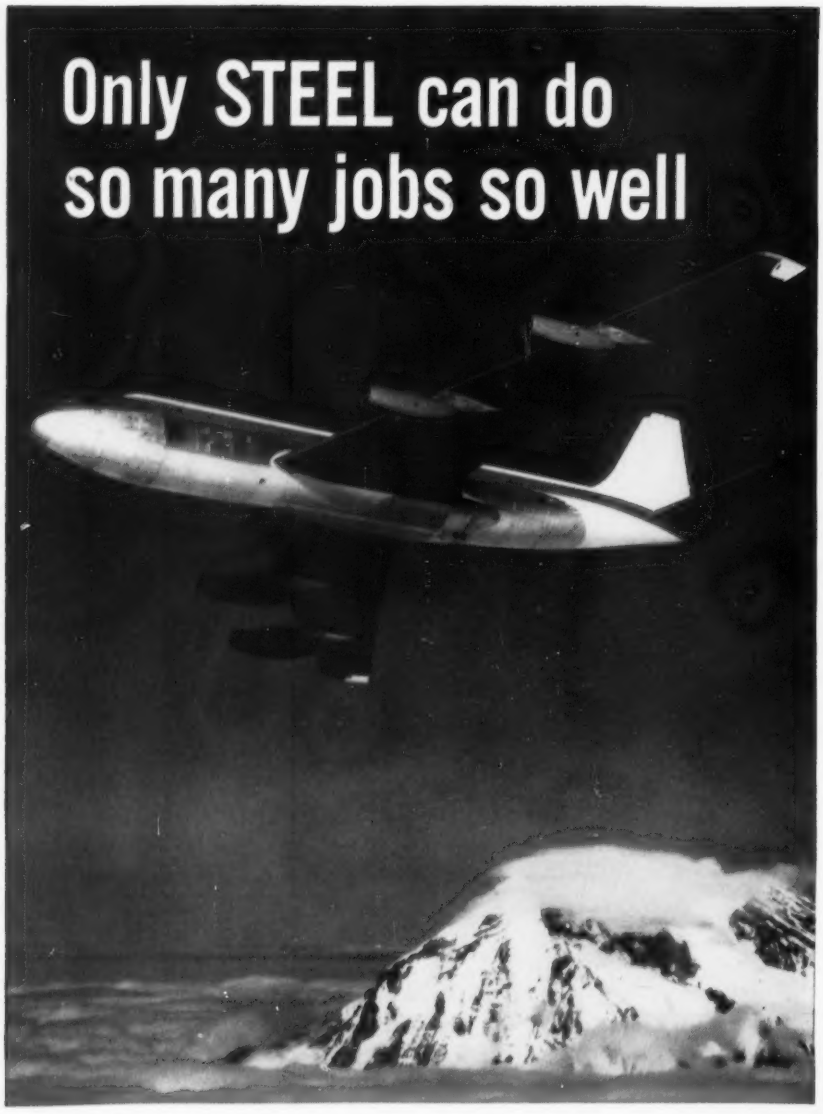
COLLEGE OF ENGINEERING · CORNELL UNIVERSITY

the Cornell engineer



OCTOBER, 1956
VOL. 22, NO. 1
25 CENTS

Only STEEL can do so many jobs so well



On Top Of The World. Boeing's 707 Jetliner looks down on the mountain tops as it flies far above the clouds. USS steels are widely used in this proud new airplane—in control cables, engines, landing gears and countless other places.

Now—A Non-Stick Slide. Remember how you used to stick on playground slides because they would rust? One manufacturer builds the slide out of USS Stainless Steel, and it stays bright and shiny in any kind of weather.

Made For Tough Nuts. It's a geared nut tightener (and loosener) made for heavy-duty use. The device uses Shelby Seamless Mechanical Tubing for maximum strength. USS Shelby Tubing is actually pierced from a solid billet of fine steel. The tubing is hot worked and forged in the process, and it contains no welds.

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MANUFACTURED FROM USS STEEL UNITED STATES STEEL

This trade-mark is your guide to quality steel

For further information on any product mentioned in this advertisement, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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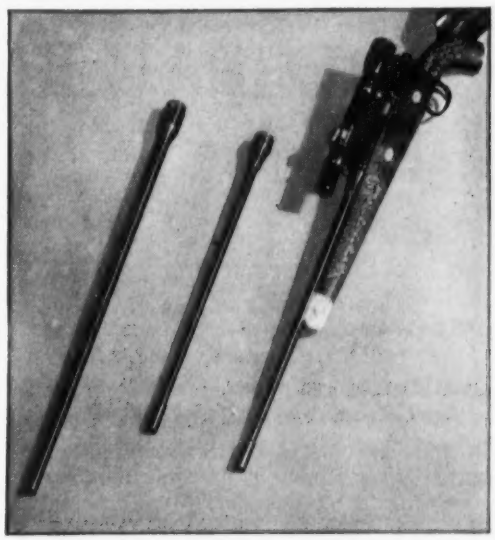
SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

Another page for **YOUR STEEL NOTEBOOK**

The rifle barrel steel that makes hunting more fun

A .30/06 rifle can get heavier toward nightfall! That's why a prominent gunsmith never gave up looking for a new steel—one that would be lighter, would machine readily, and yet would take the enormous firing stresses of even heavier calibers.

Steels normally used for lightweight barrels gave all kinds of trouble to the gunsmith: distortion, poor finish, high tool costs, trouble with drilling, reaming, rifling. They took this problem to Timken Company metallurgists—and got the perfect solution.



This TIMKEN® rifle barrel steel is free from internal stresses

Developed by the Timken Company, this new steel (center barrel, in picture) made possible a rifle barrel 6″ shorter, 2 lbs. lighter than the previous barrel of the same caliber (left). It withstands the wear of thousands of rounds of firing. Machines to highest accuracy—and to high finish beauty. Machines without distortion. Drills, reams and rifles perfectly. Proof tests to 70,000 lbs. per sq. inch for safety in a .30/06. Has handled overloads up to 100,000 lbs. per sq. inch. Timken Company metallurgists are leading specialists in fine alloy steels . . . as this remarkable new steel will testify.

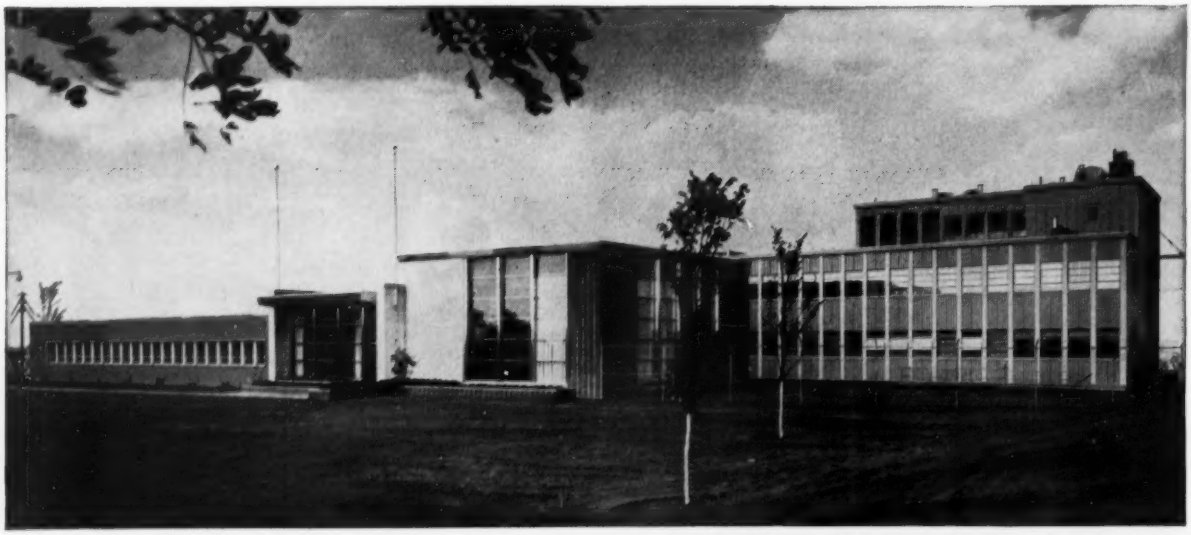
Want to learn more about steel or job opportunities?

Some of the engineering problems you'll face after graduation will involve steel. "The Story of Timken Alloy Steel Quality" will help you learn more about steel. And you might be interested, too, in the excellent job opportunities described in "Career Opportunities at the Timken Company". Drop us a card, ask for one or both booklets. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG U.S. PAT OFF

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING



Graham Laboratory for J&L Research, Pittsburgh

THE REWARDS OF RESEARCH— Jobs with a Future

Opportunities for technical and engineering students in Jones & Laughlin's ¾-billion dollar expansion and improvement program

A vigorous program of research is under way at Jones & Laughlin Steel Corporation, the nation's fourth largest. This program in a growing, progressive company provides many opportunities for qualified men in all phases of fundamental and applied research.

At J&L, research is conducted in the following areas:

METALLURGY—properties of steels and other metals • steel quality • process improvement • corrosion • coatings.

CHEMICAL RESEARCH—analytical methods, including X-ray analysis, spectrography, applied nuclear techniques • non-metallic elements in steel • chemistry of smelting and steelmaking.

INSTRUMENTATION—electronics • development of instruments for measurement and control • automation.

STEELMAKING—development of improved methods and procedures in smelting, refining, ingot practices, heating, rolling.

ORE RESEARCH—beneficiation • agglomeration • process studies.

COAL CHEMICALS—process development • organic chemical analysis.

To pursue research in these and other areas, J&L's Research Division has fine opportunities for Chemists, Metallurgists, Physicists, Chemical Engineers, and Electrical Engineers.

There are opportunities for competent technical personnel in fields other than research. To plan and man new mills and new processes, J&L also needs Civil Engineers, Metallurgical Engineers, Design and Development Engineers, and Industrial Engineers.

Other good jobs with a future exist in Production, Accounting, Industrial Relations and Sales. Training programs accelerate the application of formal college training to industrial practice.

For further information about the job opportunities at J&L, consult your college placement bureau, or write to Dept. A-7E, Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

Jones & Laughlin
STEEL CORPORATION · PITTSBURGH

J&L STEEL

Left to right: Main Research Building, Service Building, Manufacturing Development Building (behind water tower), Engineering Building, Styling Building and Styling Auditorium Dome facing 22-acre lake, focal point of GM Technical Center.

The young engineer's opportunities with General Motors

A FEW MONTHS AGO—after nearly 11 years in the planning and construction—General Motors officially opened its vast new Technical Center on the outskirts of Detroit.

Here, on 330 acres of beautifully landscaped campus, stand twenty-five superb air-conditioned buildings, replete with all the new wonder instruments of modern science and engineering.

It is the world's largest institution devoted to the industrial arts and sciences. It houses more than four thousand engineers, scientists, stylists and technicians delving into the unknown in search of new materials, new forces, new techniques.

Its huge resources and research facilities are at the beck and call of GM engineers in any of GM's 126 plants in 68 American cities.

Between the engineers at the Center, and those with any of GM's 34 decentralized manufacturing divisions, there exists a two-way flow of stimulating ideas and mutual assistance.

For young engineers now faced with the problem of building their careers, this new Technical Center is a monumental symbol of the importance that GM attaches to engineering and research.

It is a living affirmation of GM's faith in the future that modern technology will create.

It is a multimillion-dollar investment in what General Motors President Harlow H. Curtice has termed *"the inquiring mind."*

And above all—if you are a senior engineering student who can measure up to the challenge—it is further proof that you will find at all General Motors divisions a creative climate for building a rewarding career in your chosen profession.

GM Positions Now Available in These Fields

—in GM Divisions throughout the country

MECHANICAL ENGINEERING

CHEMICAL ENGINEERING

ELECTRICAL ENGINEERING

INDUSTRIAL ENGINEERING

METALLURGICAL ENGINEERING

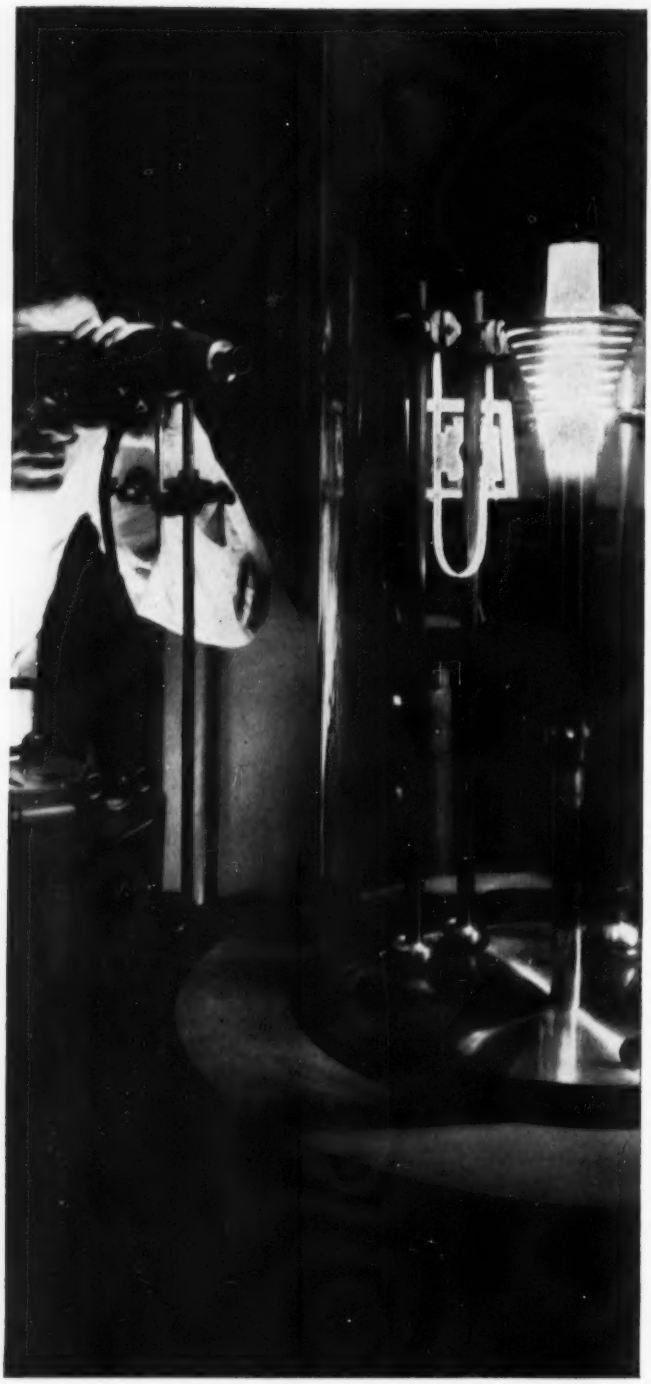
AERONAUTICAL ENGINEERING

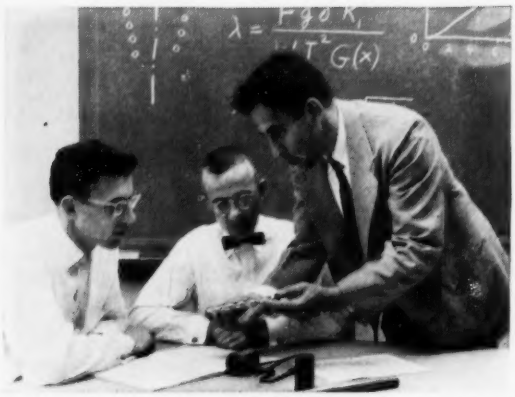
GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan

Refining metals to perfection

...A PROBLEM IN PURITY





ENGINEERS AT WESTINGHOUSE FACE CREATIVE CHALLENGES LIKE THIS EVERY DAY

Preparing superpure titanium and other hard-to-get metals was a tough problem, but Westinghouse scientists solved it. Their method, called cage-zone refining, uses an unusual method to melt a bar of metal while the metal acts as its own crucible, preventing contamination by a container.

Westinghouse offers you the opportunity to work on similar stimulating, challenging projects. Investigate career opportunities at Westinghouse, where the big expansion program means real chance for growth and progress for Electrical, Mechanical, Chemical or Industrial Engineers, Physicists, Mathematicians and Metallurgists.

In this one diversified company, you can do the kind of work you prefer . . . in the field of your choice—radar, decision devices, automation, electronics or nuclear energy. There's plenty of room at Westinghouse to move around—and up!

Million-dollar Educational Center offers a complete training program, and Master's and Ph.D. degrees can be earned at company cost at 22 colleges and universities.

Have your placement officer make a date for you now with the Westinghouse Interviewer, who will be on campus soon. Meanwhile, write for *Finding Your Place in Industry*, and *Continued Education in Westinghouse.*

Write: Mr. P. B. Shiring, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 40 Wall Street, New York 5, New York.

G-10300

Westinghouse

Another engineering first—the Boeing jet transport-tanker

The KC-135, shown on the production lines of Boeing's Transport Division, is America's *first* jet transport-tanker. It gives the Air Force a refueling craft that matches the performance of today's jet-age fighters and bombers. In its transport role, the KC-135 becomes our defense forces' first personnel and critical-cargo carrier geared to the speed and altitude demands of jet-age operations.

Boeing production engineers — who helped turn out 888 piston-driven tankers in this same Transport Division plant — are now working full time on jet-powered aircraft. Boeing's big and growing backlog of orders for both commercial and military aircraft creates constantly expanding opportunities for production engineers of all types — civil, mechanical, electrical, aeronautical, industrial.

At Boeing, production engineers find the kind of challenge that helps them grow in professional stature. They enjoy the satisfaction of working on such nationally important projects as the B-52 eight-jet intercontinental bomber, the 707, America's *first* jet airliner. Guided missiles, supersonic and nuclear-powered aircraft are other Boeing projects with a long-range, exciting future.

Here's some measure of your advancement potential at Boeing: during the last 10 years, the number of Boeing engineers has increased 400%. With that kind of growth, there are always opportunities for advancement. They could be *your* opportunities, for Boeing promotes from within. Every six months a merit review gives you an occasion for recognition, advancement, increased income.

At Boeing, you live in progressive, young-spirited communities, with good housing and recreational activities. You work with men outstanding in the world of engineering, on projects of tremendous importance to your country. You look forward to one of the most liberal retirement plans in the industry. There's job stability, and a limitless future, at Boeing — in production, and in design and research as well.

For further Boeing career information consult your Placement Office or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 24, Wash.

F. B. WALLACE, Staff Engineer — Personnel
Boeing Airplane Company, Wichita, Kansas

A. J. BERRYMAN — Admin. Engineer
Boeing Airplane Company, Melbourne, Florida

BOEING

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ALCOA WANTS YOU

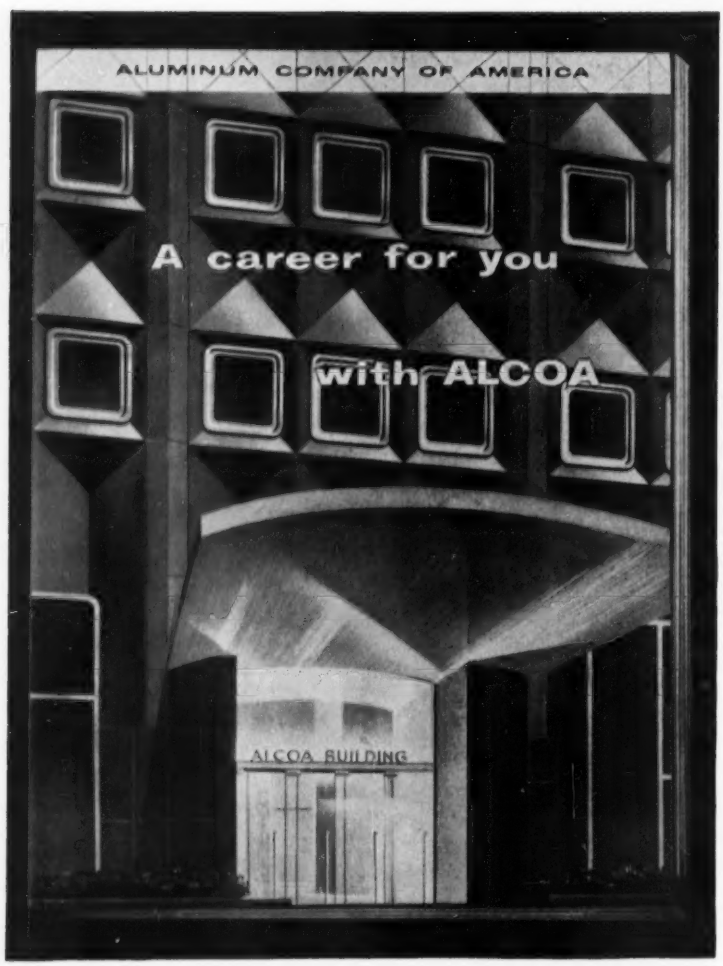
Here's a book that tells about exciting career opportunities in every branch of engineering

The opportunities at Alcoa are so many, so promising, so rich in recognition it took a book to tell the story. And Alcoa wants *you* to have a copy.

If you choose a career with Alcoa, you'll get intensive training from the men who built the aluminum business. You'll have the opportunity of working in our production plants . . . sales offices . . . research laboratories; and positions are open in almost every section of the country. Your work will be challenging and your associates stimulating.

The whole fascinating story of careers with Alcoa is told in this colorful new book. See your Placement Director or send in the coupon below for *your* copy of *A Career for You With Alcoa.*

Your Guide to the Best in Aluminum Value



Tune in the ALCOA HOUR, television's finest hour of live drama, alternate Sunday evenings.

Write for your copy today!

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Please send me a copy of *A Career for You With Alcoa.*

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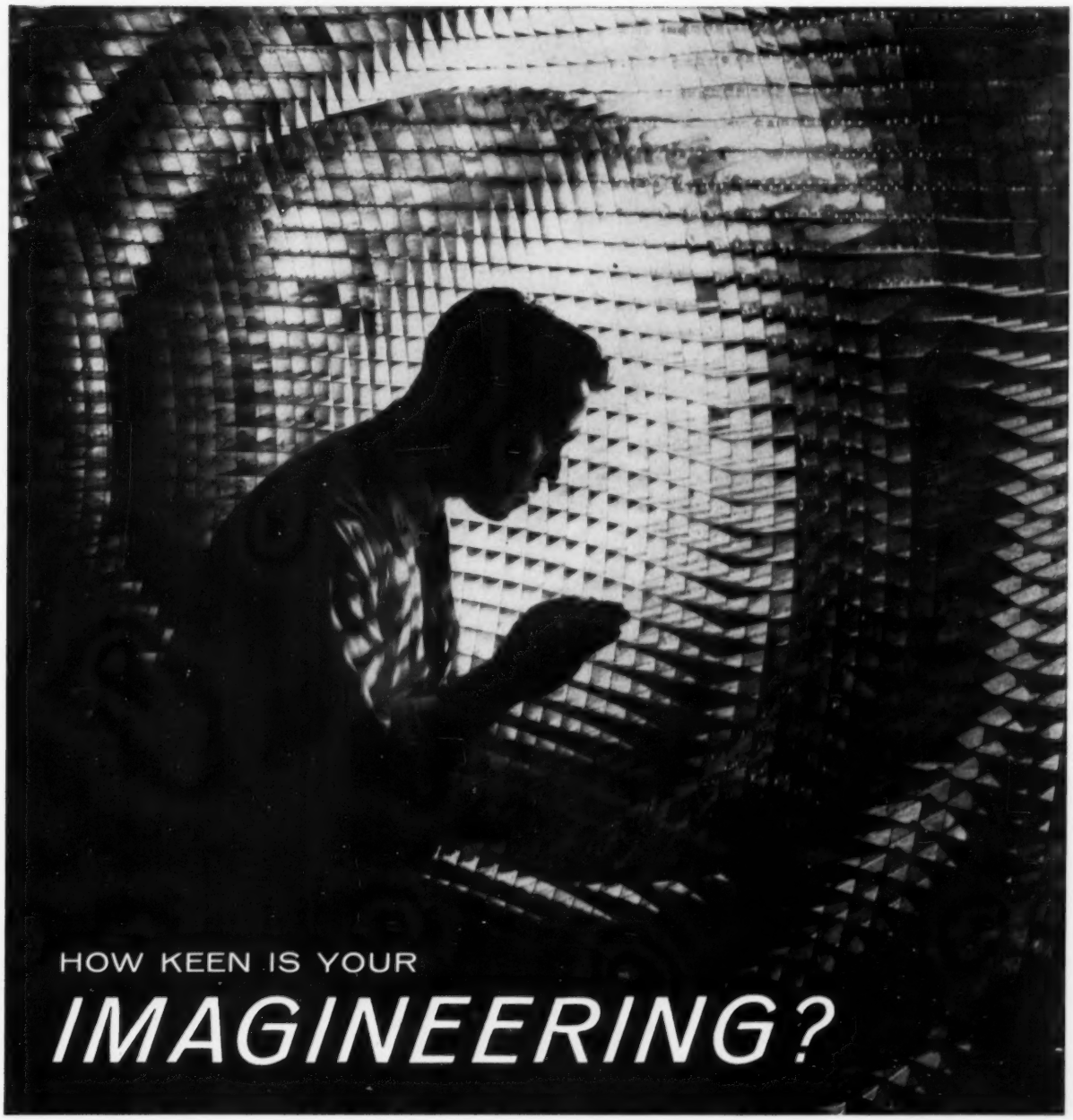
City and State_____

College_____ Degree_____ Date of Graduation____



Behind this Sperry engineer you see a complex development in one of the nation's guided missile programs. Can you imagine what it is?

■ Imagination is a valuable trait for the engineer making his career with Sperry. For here there are many challenging opportunities to be met in such fields as missiles, inertial guidance, radar, computers, microwaves and gunfire control. And while you work with the acknowledged leaders in these fields you can further your formal education—with Sperry paying your full tuition for advanced or continuing studies.

■ Whether you elect to work with Sperry in its modern plant in Long Island, or in Florida, California, Virginia or Utah, there is a bright future for you at Sperry, and one limited only by your own desire to get ahead.

■ Check your Placement Office for dates when Sperry representatives will visit your school. Make it "a must" to talk with them or write J. W. Dwyer, Sperry Gyroscope Company, Section 1B5.

P.S. In case you *didn't* identify the equipment shown above, it is part of an 8 ft. Sperry-designed radar antenna for long range missile guidance.

SPERRY GYROSCOPE COMPANY
Great Neck, New York
Division of Sperry Rand Corporation

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ENGINEERING HORIZONS UNLIMITED

Bendix

Opportunity. A chance to do something really important. That's what young engineers are seeking in a job these days. Here again, Bendix Aviation Corporation has a great deal to offer you.

Take opportunity. Bendix is a big, stable company, so there's practically no limit to the heights you can reach. Yet, because of the Bendix system of smaller, decentralized, individual divisions, your abilities and accomplishments will be readily recognized.

At divisions located across the country, Bendix engineers are doing exciting things in engineering and research in electronics, electro-mechanics, ultrasonics, systems analysis, computers, automation and controls, nucleonics, hydraulics, instrumentation, solid state physics, combustion, metallurgy, and many related fields.

Constantly working at widening engineering horizons, Bendix divisions employ a growing professional staff of over 3,000 engineers and a supporting engineering staff of 6,000 men and women.

Wherever you want to work, whatever your specialty in engineering or science—you will want to investigate Bendix opportunities. Meet Bendix representatives when they visit the campus. See your placement director for further information and exact interview dates; or write to the Bendix executive offices for information and a copy of the brochure "Bendix and Your Future".

A thousand products

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AVIATION CORPORATION
Fisher Bldg., Detroit 2, Mich.

a million ideas

A Tower of Opportunity

for America's young engineers with capacity for continuing achievements in radio and electronics

Today, engineers and physicists are looking at tomorrow from the top of this tower . . . the famed Microwave Tower of Federal Telecommunication Laboratories . . . a great development unit of the world-wide, American-owned International Telephone and Telegraph Corporation.

Here, too, is opportunity for the young graduate engineers of America . . . opportunity to be associated with leaders in the electronic field . . . to work with the finest facilities . . . to win recognition . . . to achieve advancement commensurate with capacity.

Learn more about this noted Tower of Opportunity . . . its long-range program and generous employee benefits. See your Placement Officer today for further information about FTL.

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Federal Telecommunication Laboratories FTL

A Division of International Telephone and Telegraph Corporation
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Editorial . . .

Cornell Activities

Autumn is the season of new faces on a college campus. Most of the new faces are those of the freshman class, faces that show their enthusiasm and expectancy. Some of the upper-classmen have also put on new faces since last June. There is a little more optimism that this is going to be the best year yet in their Cornell career. After a summer's rest there is a little less tension and fewer worried brows. Here is a new school year; now let's see what we can do with it.

Starting out with enthusiasm is, of course, the first step to making this a successful year. Keeping this enthusiasm is the next step. Somehow, we've got to keep from being discouraged by one or two poor prelims. We've got to concentrate on lectures so we'll learn the first time we hear the material. We've got to get some outside interest to add variety to our hours of studying.

Cornell offers a wealth of extracurricular activities. There are, of course, the organized activities such as student government, publications, Straight committees. These organizations give many people a sense of satisfaction in seeing the results of their efforts as well as the enjoyment of working with others toward a common goal. Sports of all kinds help a great deal to relax you after long sieges of studying. A little social life also is a vacation from studying.

It seems to me that there are some other activities at Cornell which are too much neglected by engineering students. These are the lecture series and concert series sponsored by various groups. Engineering students have very few electives and many of these electives are given to technical courses because of the general feeling that we need all the technical knowledge we can get. While this is probably true, it is also a fact that a person with only technical knowledge has a rather narrow education and outlook. The personality must be developed as well as the mind, and it is a variety of interests that make a man more interesting to himself and to others.

Have you read the book or seen the movie *Kon Tiki* and thought that it might be interesting to learn more about anthropology? This fall, the Messenger lecture series is on Anthropology. Why not listen to a couple of the lectures and see if they interest you? A couple hours a week can always be found if you just plan your study schedule carefully.

If history or politics is a dormant interest of yours, why not attend Dexter Perkins' lecture series on several of the U.S. presidential elections? In an election year there is always a chance to learn some American government and history if we just want to listen and read.

If you like good music; don't pass up the opportunity to hear some of America's best musicians performing in Bailey Hall in the concert series. And if you have a couple of dead hours, look into the possibility of auditing a course. You may be surprised to find you have a dormant interest in English lit or ethics. It may be even more interesting than the Ivy Room; give it a try.

Of course, no engineering student has time to have a lot of outside activities. But studying will be a lot more interesting and go faster if you keep your autumn enthusiasm, and to do this there has got to be more to look forward to than more studying. Try some extracurricular activity this year and see if you won't have a happier year.

L.T.

R&D EXPANSION PROGRAM NOW UNDERWAY AT MELPAR

Westinghouse Air Brake Subsidiary Doubling in Size Every 18 Months

One of the Nation's leading electronic research and development organizations, Melpar, Inc., is proceeding with an expansion program involving increases in both facilities and staff, according to recent announcement.

The Company has doubled in size every 18 months for the past decade; completed the erection of complete new headquarters laboratories near Washington, D. C. last year; is now making considerable additions to its Watertown, Mass. laboratory (6 miles west of Boston), and to its research department in Boston.

Located on a 44-acre landscaped tract in Fairfax County, Melpar's main laboratories encompass 265,000 air-conditioned square feet under a single roof. In addition to the headquarters plant, Melpar maintains extensive facilities in Arlington, Virginia; Boston and Watertown, Mass.

Washington, D. C. and Boston Offer Stimulating Environments

Melpar's R & D operations are centered near and in two of the country's most stimulating cities. Both are rich in cultural and educational facilities. Both cities are seats of academic leadership and are rich in research sources.

Within easy driving range are beaches, many other recreational and scenic points, as well as historic shrines. In the Washington, D. C. area the climate allows outdoor recreation 215 days of the year. In fact, the whole National Capital area is one vast playground. Melpar pays re-location expenses for families moving to either the Washington, D. C. or Boston areas.

Melpar Advancement Policies Stress Performance

Regardless of age or tenure, engineers at Melpar may move ahead as fast as their skill and performance indicate. There is no waiting period for "automatic" advancement. Each engineer's achievement is reviewed at least twice a year. In this manner men of ability can be quickly "spotted" and promoted at Melpar. As soon as an engineer is ready for more complex responsibility, it is given him.

No Formal Training Period at Melpar

The college or university graduate who joins Melpar is not required to undergo a formal training program. Instead he immediately becomes a member of a project group, and is assigned to work with an experienced engineer who gives him guidance and assistance. Members of Melpar project groups gain experience in *all* phases of development problems by free and frequent interchange of ideas during the group meetings. Such experience is valuable in leading to eventual managerial responsibility.

Melpar R & D Activity In Varied Fields

Flight Simulators • Radar and Countermeasures • Network Theory • Systems Evaluation • Microwave Techniques • Analog & Digital Computers • Magnetic Tape Handling • UHF, VHF, or SHF Receivers • Packaging Electronic Equipment • Pulse Circuitry • Microwave Filters • Servomechanisms • Subminiaturization • Electro-Mechanical Design • Small Mechanisms • Quality Control & Test Engineering

Financial Assistance Offered by Melpar For Graduate Work

The list of universities located near Melpar laboratories which offer graduate or undergraduate courses in engineering subjects includes: Georgetown University, George Washington University, American University, Catholic University, University of Maryland, University of Virginia, Harvard, Massachusetts Institute of Technology, Northeastern University and Boston University. Melpar offers financial assistance for study at any of these universities.

Graduate Courses Held At Melpar's Main Lab

Melpar staff members, both holders and non-holders of degrees, may take advantage of fully accredited courses offered at the Melpar headquarters laboratory.

Melpar's personnel policies and salary structure compare favorably with those in the industry as a whole. The Company maintains a liberal program of benefits too extensive to detail in this space.

Paid Inspection Trips Given Qualified Graduates

Information on opportunities available for graduates at Melpar together with details on living conditions in the Washington, D. C. area is now available. Simply write: Mr. William Schaub, Melpar, Inc., 3000 Arlington Blvd., Falls Church, Virginia. Qualified candidates will be invited to visit Melpar at Company expense. Watch your campus newspaper for announcement of a visit to your area by a Melpar representative who will be available for confidential interviews.

Mars Pencils Sponsors Tomorrow's Designs

MARS OUTSTANDING DESIGN SERIES—featured in the current advertising of J. S. Staedtler, Inc.—has attracted widespread attention among the users of fine drafting pencils. It has fulfilled our expectation that the men who appreciate the finest working tools are those with a lively creative interest in new designs, new projects, new ideas.

Concerned with unusual projects—*designs of the future*—Mars Outstanding Design Series provides a "showcase" for originality, for interesting work of engineers, architects, and students which so often lies buried. To stimulate you to send in *your* designs, Mars Pencils

will pay you $100

for any design accepted. This $100 is paid you simply for the right to reproduce your project in the Mars Outstanding Design Series. There are no strings attached. You will be given full credit. (See ad on this page—one of the ads in the current series.) All future rights to the design remain with you. You can reproduce it later wherever you like and sell or dispose of it as you wish.

The subject can be almost anything—aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment, etc. It should be a project that appeals to design-minded readers, be of broad interest, and be attractively presented. Do not submit a design that has been executed. As a matter of fact, the project does not need to have been planned for actual execution. It should, however, be something that is either feasible at present or a logical extension of current trends. It cannot be unrealistic or involve purely hypothetical alterations of natural laws.

There is no deadline for entries but the sooner you send yours in, the greater the probability of its use as one of the subjects in the 1957 Mars Outstanding Design Series.

It Is Simple To Submit a Design For Mars Outstanding Design Series

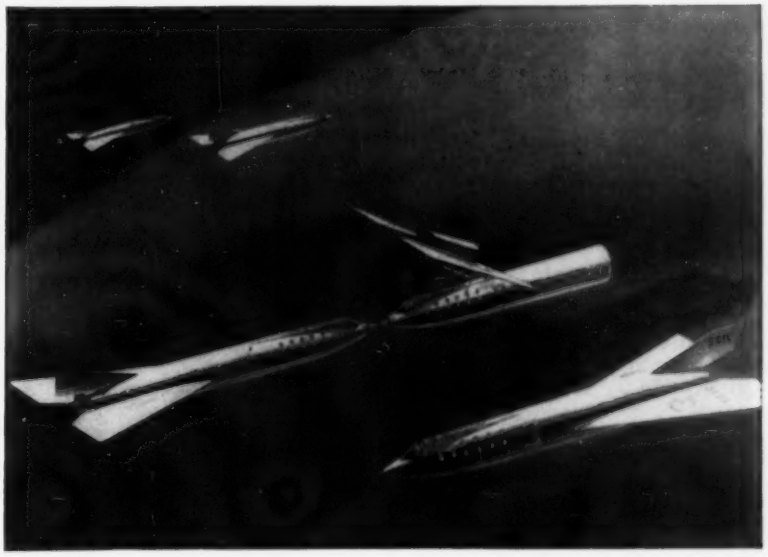
Just mail in an inexpensive photostat or photocopy of the subject—one you can spare, since it cannot be returned.

If your entry is accepted, we will ask you to send in a sharp photograph of the design, or the design itself, so that we can make a sharp photograph suitable for reproduction—after which it will be returned to you promptly.

Send your entry to:

J.S. STAEDTLER, INC.
DICAROLIS COURT, HACKENSACK, NEW JERSEY

MARS outstanding design **SERIES**



birth of a satellite

Most new ideas, like this inhabited satellite, start out as drawings on a sheet of paper. Here artist Russell Lehmann shows the first step in building the space station proposed by Darrell C. Romick, aerophysics engineer at Goodyear Aircraft.

Two ferry ships, one stripped of rocket units, are joined end to end. As others are added, this long tube forms temporary living quarters for crews. Eventually, outer shell will be built around core, making completed station 3,000 feet long, 1,500 feet in diameter.

No one can be sure which of today's bright ideas will become reality tomorrow. But it is certain that in the future, as today, it will be important to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars — from sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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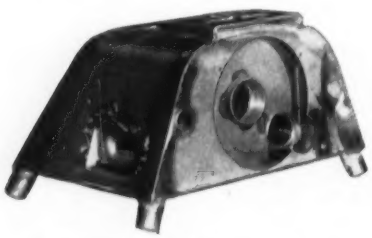
A LOOK AT FUTURE DESIGN

How to prepare for it

NEEDS for even more efficient machinery are daily presenting new demands on the ingenuity of machine designers. In the same way, products themselves must incorporate even greater economies in materials and in manufacture to help keep pace with the pressures of growing competition. This trend in design thinking, therefore, poses a promising challenge to the student engineer.

Rapid strides in the use of welded steel construction point the way to a brilliant opportunity to pioneer new concepts in the field of product design engineering. Fundamentally, steel itself is the most economical material for many products, based on steel's inherently high strength, rigidity and low cost. The challenge, of course, is how to utilize the steel to its maximum advantage.

Here welding holds the answer to new savings in cost of manufacture. New welding electrodes, new welding techniques being introduced almost daily offer new avenues to obsolete production methods of long standing. Typical savings through the use of welded steel are shown in the following example.



All-welded headstock for power drive is made from 16 gauge sheet. Estimated to be 20% more rigid, weigh 28% less, cost 44% less than cast iron design. Photo courtesy Oster Manufacturing Company, Cleveland, Ohio.

It is to your advantage to keep pace with the progress of welding techniques. You can start with helpful manuals and bulletins available to you by writing . . .

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COVER: The "Libe" Tower, landmark and symbol of Cornell University.

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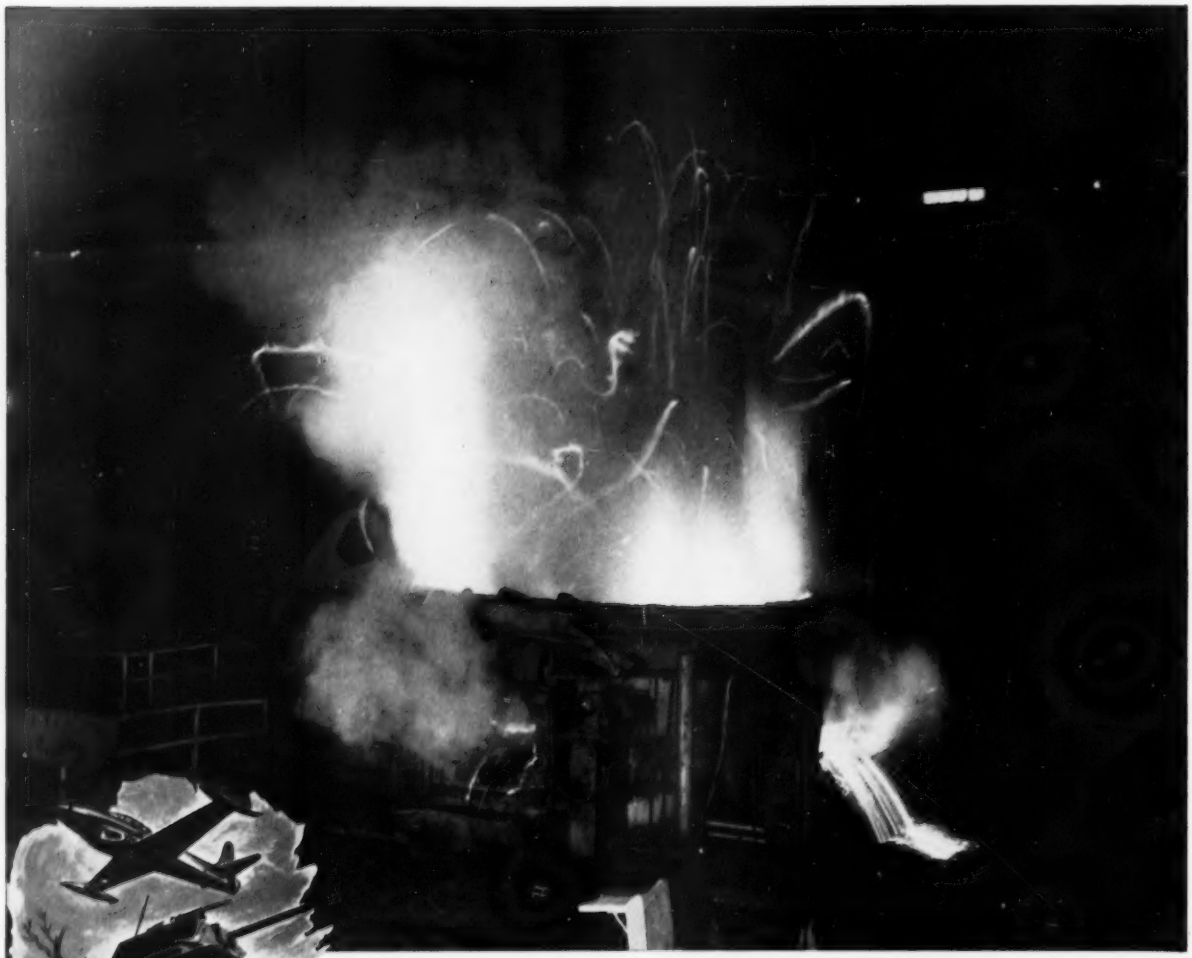

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Safety by Survival

by

Harry Fertik, M.E. '59 and David Lamensdorf, E.E. '60

On U.S. highways:

One person is injured every 15 seconds.

One person is killed every 14 minutes.

Excessive speed, drinking and carelessness are the major causes of traffic accidents. Through the work of safety campaigns this has become common knowledge and yet, twenty-four hours a day, the devastating toll continues to grow.

Up until now, the safety campaign's emphasis has been on *causes* and *prevention*. But since accidents always happen, despite the best law enforcement efforts, highway engineering, and driver licensing, it is now necessary to also consider *survival*. How can we provide the victims of unavoidable accidents the best possible chance of escaping injury or death?

Automotive Crash Injury Research, located in New York City and directed and coordinated by the Cornell University Medical College, is a fact-finding project which produces, for the first time, information concerning the specific causes of injury to the occupants of passenger automobiles involved in accidents. Its laboratory is the open highway and the crowded city. Its investigators are the state troopers and police officers who race to the scene of the accident. They examine the wreckage and from tell-tale dashboard dents, twisted steering wheels and cracked windshields, detect the possible causes of injury. Doctors treating the victims note on medical forms the location, severity and extent of all injuries sustained. The complete reports are then analyzed by experts and coded on IBM card decks for statistical use.

From the 1500 case studies per year the research association has both refuted and reinforced several commonly accepted notions about auto accidents.

The first of these is the idea that being "thrown clear" of an accident is no protection. In fact, ejection from the car more than doubles the risk of moderate to fatal injury. In more than half the injury producing accidents, front doors will fly open, ejecting one out of three occupants. John O. Moore, director of the Crash Injury Research writes, "One of the primary means of attacking the epidemic of automobile injuries is the development of a method of keeping the occupants inside the protective body of the vehicle."

The second most frequent cause of injury is when passengers riding in the front and rear seats are slammed against the windshield or dashboard. The driver, however, is not protected either, for the steering post is like "a spear aimed at the heart of the motorist," ready to strike when there is a sudden stop. About 40% of all injured drivers are hurt as they are thrown forward on the steering wheel assembly.

When discussing the fundamentals of crash injury research, the Cornell Crash Injury Research men refer to the "packaging principle." They consider the occupants of motor vehicles as "valuable goods in transit." Who would pack a delicate vase in an oversize cardboard box without protective cushioning? Yet that is how auto passengers are transported every moment. The researchers are systematically checking the package (motor vehicle) using the packing engineer's four principles. As stated by Hugh De Haven, the past director of research, they are first, "the package should not open up and spill its contents and should not collapse under reasonable or expected conditions of force." Second, "the packaging structures . . . should resist force by yielding and absorbing energy applied to the outer container so as to cushion and distribute the impact. Third, the "articles contained in the package should be held immobilized inside the structure by interior packaging." Fourth, "the means of holding the object inside the container should be such as to transmit forces to the strongest parts of the contained object."

In an attempt to discover how much punishment the human body can tolerate Hugh De Haven studied the records of accidental falls and suicide jumps. He was trying to determine the conditions under which certain people survived falls of almost 100 feet and apply these conditions to aircraft and motor vehicles. De Haven found that in cases of survival the force of the fall was dissipated over a large body area and the substance on which the victim landed would bend or deform, absorbing much of the force.

Many companies are now carrying out extensive research in the

←

Frontice—The two cars, with their life-like dummy passengers, are shown in the top photo at the instant of impact. In the second photo, the dummy in the crash car's right front seat strikes the padded sun visor while the dummy in the driver's seat hits the deep-center steering wheel, which distributes the force and absorbs the energy of the crash. The dummy in the parked car is also restrained by a seat belt. He momentarily slides over into the seat and then rights himself in the third photo. Although the parked car was struck in a vulnerable spot, all doors remained closed because they were equipped with safety door latches. Ford Motor Co.

A safety research technician is shown releasing a 160 pound "body block" into a steering wheel in a test which will determine how much energy the wheel can absorb before failure. Ford Motor Co.

field of survival safety. Typical of the work being done is that of the Cornell Aeronautical Laboratory in Buffalo, New York, who, in one project, used a lightweight two-door sedan to simulate crashes in order to gather time motion characteristics of the human body in relation to the interior of the automobile. A controlled deceleration was designed into the car rather than creating an actual crash for each test. This was accomplished by attaching a steel cable, 200 feet long and two inches thick, to the bottom of the car. The car was run and steered, by remote control until the cable pulled it to a stop. The ignition in the car was shut off automatically just before stopping to prevent the possibility of a fire occurring. In the car, during these tests, were placed two life-like dummies, one adult and one the size of a six-year-old child. Through the use of high speed cameras, the motions of the dummies during the simulated crash were studied. The dummies' heads were chalked to show where they came in contact with the car.

From these tests, the driver was found to consistently sustain a chest blow against the steering wheel and a head blow against the upper windshield. From the right front seat, the adult-sized dummy impacted first the upper windshield, moulding or headliner, and then the top of the instrument panel. Motions of rear seat occupants were found to be less predictable due to the greater distance traveled.

The high speed motion pictures proved invaluable in determining the motion of the dummies since it was next to impossible to trace the path from a post-crash examination. In one test, the dummy was thrown forward from the rear seat, struck hard on the windshield and then returned to its same position in the rear seat. Crashes at speeds of only 17 miles per hour could have tragic results, the investigators learned.

Ford Motor Company, using similar tests, employed four electromechanical devices called accelerometers to measure the force with which the head and body struck the car. They were attached to the frame of the car and to the dummies in the car. The impact of the crash caused a small metal weight in the accelerometer to be displaced, stretching a minute wire grid and thereby changing the instrument's electrical resistance and altering the flow of electricity through it. This caused a special signal to be transmitted over a cable to an accompanying instrument truck and there recorded on film as a wavy line. From the position and height of the line, engineers were able to calculate an exact time and force history of the collision. Another device which they used in order to measure points of contact of the dummy and the car was to wrap aluminum foil around the dummies' knees and foreheads and on the instrument panel, windshield, sun visor and roof of the test car. When contact was made, an electric circuit was completed and indicated in the instrument truck. The dummies which Ford used had a steel skeleton, and were covered with tough plastic to simulate muscle. This in turn was covered with a soft plastic resembling skin. The joints could be made rigid or limp according to the test conditions needed.

Their tests were primarily of two kinds. The crash car was either towed directly into another broadside, or it was towed into a fixed barrier built of heavy timber and several tons of earth.

Due to the fact that the largest proportion of automobile injuries occur to the head, special work has been done on this topic by many companies. In one group of tests at the Cornell Aeronautical Laboratory, the head was studied by dropping thousands of hens' eggs which scientists say closely resemble the human head, both being hard shells surrounding a semi-fluid. As a result of these experiments, they found that injury will be greatly reduced if the head

A demolished vehicle is shown after it has been crashed into a barrier. Research of this type is done to investigate the nature of mechanical forces applied to the human body and to determine what devices may be used to protect a human involved in an automobile collision. Holloman Air Development Center

A test dummy is pinned between seat and broken steering wheel after the car was crashed into a barrier. Accelerometers are mounted in the head and body of the dummy to determine deceleration, velocity, and other variable factors that a human may be subjected to when in an automobile wreck.

is kept from traveling far before it hits an obstruction and if it is kept from hitting hammerlike blows by padding the surface of the obstruction in order to distribute the force of the blow over a larger area of the head. In other tests, artificial heads were built from plastic and a gelatinous material. They simulated the human head in weight, shape, breaking strength and elastic characteristics. By throwing these heads from an instrumented catapault against dashboards and instrument panels, special padding and various other objects, they found that the average ten pound head can stand a blow which is the equivalent of a forty inch drop onto a hard, flat surface before injury to the brain, or a seventy inch drop before a fracture of the skull occurs. Scientists know that blows beyond this force occur in automobile accidents.

From the research which has been done, many new improvements have been developed which apply to the packaging principles and are now appearing as standard or optional equipment on most new model cars. One of these is the safety door latch, developed to prevent the doors from opening in an accident. Most companies have designed and are now using some device of this kind. As applied to the first principle of packaging, the closed door gives the body of the car more strength and rigidity and prevents the ejection of passengers. Typical of these new door latches is that developed by Chrysler Corporation which locks the door in three directions. A horizontal U-shaped striker attached to the door post prevents movement sideways and outward and a dovetail prevents movement in a vertical direction. The striker acts as a hook and is encircled by the rotor housing on the latch when the door is closed. Teeth on the rotor catch on the notches in the striker to prevent the outward movement. By having two notches on the striker, a safety position can hold the door closed even though it is not in the lock position. The prevention of sideways movement will keep the door locked to the body pillar when it is distorted in an accident. This is the cause of its opening in most accidents. When riding, doors must be locked from the inside for maximum protection, because contact during an accident can actuate the handle from the outside and release the latch, allowing the door to open.

The crash test car following a simulated crash. The dummy lay twisted and crumpled in the car's interior. The steel cable which pulled the car to a stop is connected to the bottom of the car. Cornell Aero Laboratory

Several safety features have now been developed which apply to the second principle of packaging, where the automobile absorbs the energy applied to it upon impact. Ford has introduced a modified "morning glory" shaped steering wheel. The steering post ends several inches behind the wheel, so that upon impact, the wheel slowly gives way, absorbing the shock and distributing the force over a large portion of the driver's chest area. This keeps the steering post from

(Continued on page 55)

65-year test

directs choice of valves for new Rochester home of

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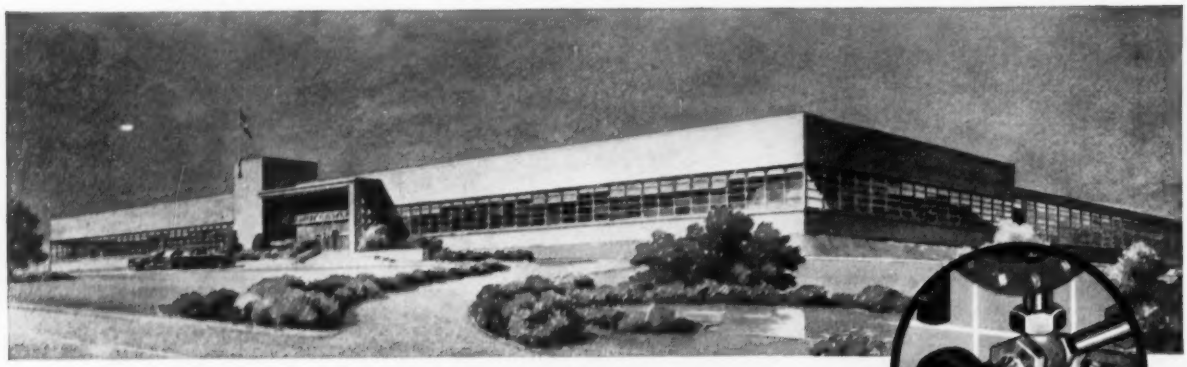

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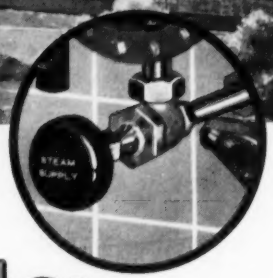

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THE HOSPITAL LABORATORY AUTOCLAVE illustrated is one of the many types of Castle Sterilizers used in hospitals and laboratories, and shows typical use of Jenkins Valves on the steam, water supply, and drain lines. Valves are renewable composition disc type, and have special heat-resistant, non-staining Bakelite handles, with each valve's function moulded in the top. Jenkins Valves provide the sturdy construction, safety, and good appearance required. They also permit quick, easy maintenance, since the renewable discs, made also by Jenkins Bros., are available anywhere from Jenkins Distributors.

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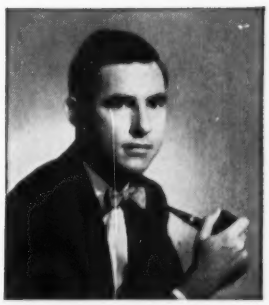
George Lincoln asks:

What do metallurgists do in a chemical company?

GEORGE M. LINCOLN, JR., expects to receive his B.S. in metallurgical engineering from Lehigh University in 1957. George was vice president of his junior class, is active in sports, and a participant in many other campus activities. He's starting his employment investigations early, for he feels that the selection of an employer is one of the most important decisions in a man's career.



CHARLES I. SMITH, JR., received his B.S. Ch.E. from V.P.I. in 1943, served in the Navy as an engineer officer, and joined Du Pont's Engineering Department in 1946. Since then, he has advanced steadily through a number of interesting assignments at various Du Pont plants. He was recently promoted to manager of the Technical Section of Du Pont's Pigments Department.

Charlie Smith answers:

They have an almost endless variety of interesting problems to face, George. As a student of metallurgy, you know that about two-thirds of all known chemical elements are metals. Many of them are revealing valuable new applications, when highly purified on a commercial scale. Du Pont is greatly interested in several metallic and semi-metallic elements.

My own experience at Du Pont ranges from work on titanium pigments, to metallic titanium production, and to the ultra-pure silicon used in transistors. You can appreciate some of our metallurgical problems when I point out that impurities in transistor silicon have to be below one part in 100 million. That's equivalent to one pound of impurities distributed through a train of ore cars twenty miles long!

Some of our metallurgists carry out fundamental research on new metals, and, in the development stage, they frequently operate pilot plants for producing them. Other metallurgists study problems relating to engineering materials used in construction, carry out research on intergranular corrosion, or investigate fatigue relationships encountered in dynamic, high-pressure operations.

You'll find many challenging opportunities in every phase of metallurgy at Du Pont, George.

Metallurgists and Metallurgical Engineers can find some of Charlie Smith's challenging new problems described in "Engineers at Du Pont." For a free copy of this booklet write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.

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Welcome to Freshmen

by

S. C. Hollister, Dean of the College of Engineering

It is a pleasure to welcome you to Cornell as members of the Freshman Class in Engineering.

I am sure you realize that you are entering now the most important period of your preparation for a lifetime career. The direction and shape of your future very likely will be determined to a considerable extent in your next five years at Cornell—five years which constitute the most productive investment you can make for a successful career. I cannot urge you too strongly to keep in mind that in this time you must establish a foundation upon which you can build a professional life for forty years or more.

Looking this far into the future, to what pattern shall we plan your engineering training? The answer to that lies in the recognition that the engineer is no longer a highly individualistic, specialized technician. He is a professional man in every sense of the word, skilled both in the use of science for the solution of broad technological problems, and in the application of rational analysis to economic, social, and business affairs. So it is that, whatever your immediate field of interest may be now, you will probably find that your career will call you into many activities you cannot now anticipate.

You will find also that your scholastic training must have such firm roots that whatever advances in engineering may come about—and certainly such advances are occurring with increasing rapidity—you will have the background that will enable you to advance your own abilities with the growth of the profession, and in fact provide the leadership for that growth. This has been the Cornell tradition.

A final objective you must have in mind throughout your college career is this: that both through your formal study and your many activities outside the classroom you will accept the stimulation that is all about you for broad intellectual growth, so that you will be prepared to take leadership as a citizen in the whole range of human affairs as well as in your professional work. In order to benefit fully from your association with Cornell, you should endeavor to become familiar with its distinctive personality and its historical development. There is much inspiration in the story of Cornell and I hope you will seek it out. You will find, for example, that at its beginning, Cornell represented a radical departure from the classical concept of higher education which would not tolerate the practical sciences as fit subjects for major study at this level. Ezra Cornell himself determined that training in engineering, science, and the humanities should stand side by side here, each benefiting from the others.

Dean Hollister

So it was that, within a very short time, Cornell engineers were taking a dominant part in the great industrial development and the great advances in transportation and communication which began about that time. This traditional role of the College continues to the present time. You will see around you the physical evidence of our planning for the future, with a number of new engineering buildings in use or under construction. Of even greater importance, however, is the Cornell of human beings, human ideas, and human enthusiasms. Your full participation in this fraternity will establish the return on your investment.

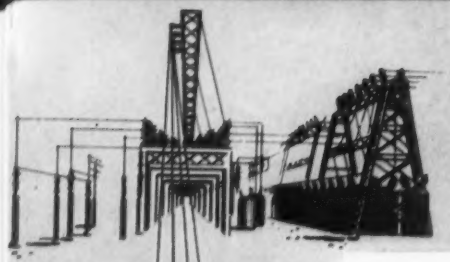
The engineering curricula at Cornell provide a superior educational preparation, second to none. They are designed to train for leadership and as such they are demanding of our best mutual efforts. I can assure you that we are determined to work with you in every way possible to bring about the most effective kind of educational experience.

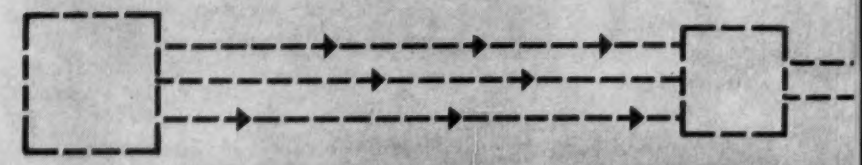
It would be unrealistic, however, to expect that the path will be smooth and troublefree for all. It is likely to be the most challenging you have ever attempted, but by the same token also the most rewarding. For some the adjustment of these first few weeks may be difficult and perhaps even momentarily discouraging, but I want you to know that we stand squarely behind you, asking in return your own sincerity of purpose. You have been chosen for the engineering program at Cornell on the basis of a highly selective admission procedure. We think you can become a Cornell Engineer, and our every effort is directed toward having you take your place in this distinguished family.

In urging you to your maximum effort I do not intend to sound an unnecessarily stern note. This is a joyous occasion and the beginning of one of the most happy and fruitful periods in your life. The opportunities for your personal development will be almost limitless. Cornell is a spiritual as well as an intellectual experience and I hope that you will take full measure of all that is here.

I congratulate you on the opportunity before you.

S. C. Hollister





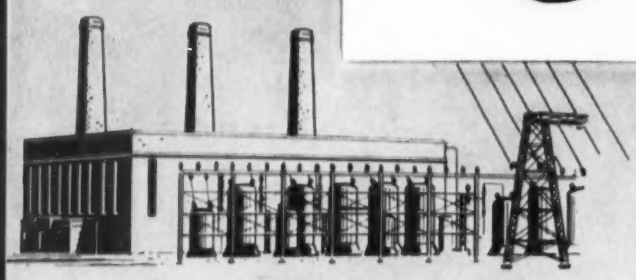
The importance of insulations for

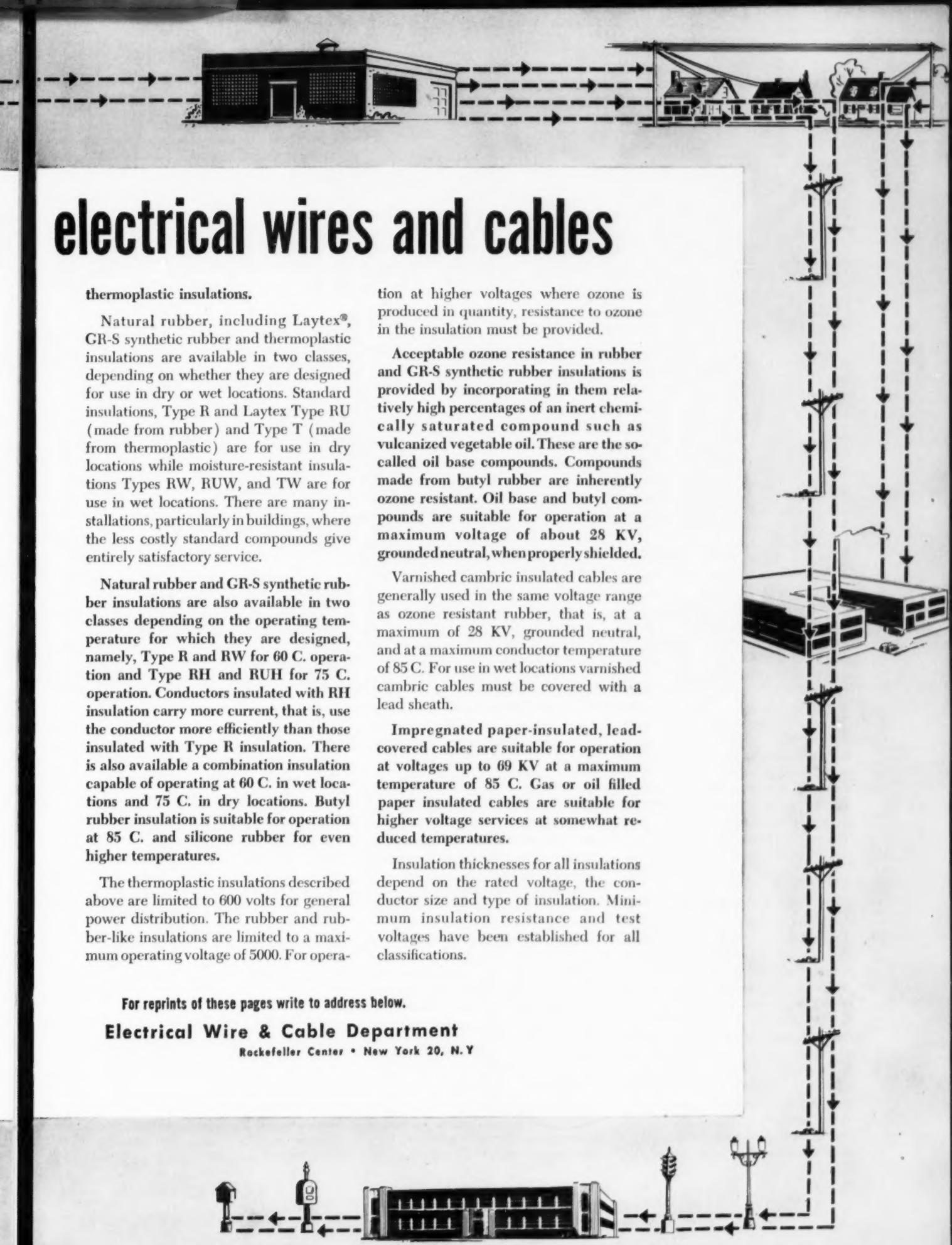
THE PURPOSE of electrical insulation is to offer resistance to the flow of electricity and thus to confine electrical potential to the conductor material throughout its length. An ideal insulating material would have infinite insulation resistance and voltage breakdown, a specific inductive capacity of 1 and zero power factor. In addition it would be flexible, physically strong and unaffected by abrading, cutting and impact forces, oxygen, ozone, acids, alkalies and water throughout a temperature range from minus 80 C. to the maximum operating temperature of copper. A conductor insulated with a thin wall of such a material would occupy minimum space and would operate indefinitely even at high voltages in the presence of any or all of the above destructive materials with no energy loss within the insulation. All available insulating materails fail to comply with the above ideal in practically every respect.

Insulations for use on electrical wires and cables which are subject to bending during manufacture, installation or use must have adequate flexibility. Flexible insulations for such uses are of two general classes, depending chiefly on the extent that they absorb or are affected by moisture. In one group are included the homogeneous rubber and rubber-like insulations, made from natural rubber or the synthetic rubbers, GR-S, butyl and silicone and thermoplastic insulations such as polyvinyl chloride compounds and polyethylene. Most of these are highly resistant to moisture. The other group consists of insulations built up of one or more layers of fibrous materials such as asbestos, cotton, varnished cambric, various synthetic fibers and paper. Even though these fibrous materials are impregnated with moisture-proofing materials such as paraffin, asphalts and oils, they readily absorb sufficient moisture in wet locations to completely lose their insulating properties. Such insulations must therefore be protected by a moisture-proof sheath such as lead when used in moist locations.

The insulations made from materials appearing in the first group fall into two general classes depending on whether or not they are vulcanized after application to the conductor, namely, (1) thermosetting insulations, those which are vulcanized and, (2) thermoplastic, those that are not vulcanized. Thermosetting insulations are those made from natural rubber, GR-S, butyl and silicone synthetic rubbers. Such insulations are applied to the conductor in a soft plastic condition and attain their ultimate physical properties as a result of a heat treatment (vulcanization) during which the sulfur or vulcanizing agents combine with the rubber. Thermoplastic insulations become plastic enough for application to the conductor simply by raising their temperature. They acquire their toughness again on cooling. From this it follows that thermosetting insulations are less subject to softening at elevated temperatures than

United States Rubber





electrical wires and cables

thermoplastic insulations.

Natural rubber, including Laytex®, GR-S synthetic rubber and thermoplastic insulations are available in two classes, depending on whether they are designed for use in dry or wet locations. Standard insulations, Type R and Laytex Type RU (made from rubber) and Type T (made from thermoplastic) are for use in dry locations while moisture-resistant insulations Types RW, RUW, and TW are for use in wet locations. There are many installations, particularly in buildings, where the less costly standard compounds give entirely satisfactory service.

Natural rubber and GR-S synthetic rubber insulations are also available in two classes depending on the operating temperature for which they are designed, namely, Type R and RW for 60 C. operation and Type RH and RUH for 75 C. operation. Conductors insulated with RH insulation carry more current, that is, use the conductor more efficiently than those insulated with Type R insulation. There is also available a combination insulation capable of operating at 60 C. in wet locations and 75 C. in dry locations. Butyl rubber insulation is suitable for operation at 85 C. and silicone rubber for even higher temperatures.

The thermoplastic insulations described above are limited to 600 volts for general power distribution. The rubber and rubber-like insulations are limited to a maximum operating voltage of 5000. For operation at higher voltages where ozone is produced in quantity, resistance to ozone in the insulation must be provided.

Acceptable ozone resistance in rubber and GR-S synthetic rubber insulations is provided by incorporating in them relatively high percentages of an inert chemically saturated compound such as vulcanized vegetable oil. These are the so-called oil base compounds. Compounds made from butyl rubber are inherently ozone resistant. Oil base and butyl compounds are suitable for operation at a maximum voltage of about 28 KV, grounded neutral, when properly shielded.

Varnished cambric insulated cables are generally used in the same voltage range as ozone resistant rubber, that is, at a maximum of 28 KV, grounded neutral, and at a maximum conductor temperature of 85 C. For use in wet locations varnished cambric cables must be covered with a lead sheath.

Impregnated paper-insulated, lead-covered cables are suitable for operation at voltages up to 69 KV at a maximum temperature of 85 C. Gas or oil filled paper insulated cables are suitable for higher voltage services at somewhat reduced temperatures.

Insulation thicknesses for all insulations depend on the rated voltage, the conductor size and type of insulation. Minimum insulation resistance and test voltages have been established for all classifications.

For reprints of these pages write to address below.

Electrical Wire & Cable Department
Rockefeller Center • New York 20, N. Y

UNIONIZATION of ENGINEERS

by

Jesse S. Tarleton, Ph.D. '57

The idea of unions for engineers and other professional employees is not a new one. As far back as 1918 the American Federation of Labor formed the International Federation of Technical Engineers. However, this union was not very successful at recruiting graduate engineers and even today contains only about 6000 members, mostly draftsmen in shipyards. In 1934 the International Federation of Architects, Engineers, Chemists, and Technicians was founded. It soon joined the Congress of Industrial Organizations and later was merged with the United Office and Professional Workers. It, too, faired poorly with engineers and was eventually dissolved because of Communist domination.

The Wagner Act

Passage of the Wagner Act by Congress in 1935 had a profound effect upon the rights of professional workers. This law guaranteed to employees the right to form collective bargaining groups, but it did not distinguish between professional and non-professional employees. As a result, when a majority of the workers in a plant voted to join a union, engineers and other professionals were often forced into this union by sheer weight of numbers. In such a heterogeneous organization they had little say, no real representation, and frequently found themselves opposed to the aims of the union.

In some plants groups of professionals were able to form their own collective bargaining units in order to prevent being drawn into a rank-and-file union. A notable example was a group of 201 engineers and scientists at Shell Development Company at Emeryville, California who resisted representation by the trade union and eventually, in 1941, won a decision from the National Labor Relations Board to form their own bargaining group.

This situation was of grave concern to all professional employees and, as a result, the engineering and scientific professional societies were leaders in the campaign to remove this inequity. Their efforts were rewarded in 1947 with the passage of the Taft-Hartley Act. This act defines a professional worker as one whose work is "predominantly intellectual and varied in character, as opposed to routine mental, manual, mechanical, or physical work; involving the consistent exercise of discretion and judgment in its performance; of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of higher learning . . ." A professional so defined could not be required to join any union unless a majority of the professionals in his plant voted to do so. In any plant the professional employees were permitted to decide for themselves, by majority vote, whether (1) to form a collective bargaining unit of their own, (2) to affiliate with another union, or (3) to join no union.

As a result of the Taft-Hartley Act, those professional unions which had been formed to prevent their members from being forced into trade unions, either dissolved, continued on as bargaining groups, or changed status into the so-called "sounding board" type of organization. These "sounding board" groups consist of engineers and other professionals, both supervisory and non-supervisory, which meet informally to discuss problems of wages, hours, and working conditions, but which do not collectively bargain.

ESA Formed

Late in 1951 a national organization of professional employees was proposed, and in February, 1952 the Engineers and Scientists of America (ESA) was formally organized. The ESA is a loose federation of some 25 autonomous local professional unions, each of which

In a large group of engineers working together, are professional feelings stifled? Armor Research

has been individually certified by the NLRB as a collective bargaining group. Its stated objectives are: to promote the social and economic welfare of professional employees, to improve employer-employee relations, to elevate the status of professional employees and provide ethical representation without affiliation with labor organizations, to further the unity of technological professions, to assist in the formation of collective bargaining units, to make the general public aware of the contribution to society by professional men. The ESA claims a membership of over 40,000, mostly in the aircraft and electrical manufacturing industries, although this figure has been disputed as being high. Its member unions include groups at Lockheed, Boeing, Douglas, Shell Development, RCA (Camden), Western Electric, Sperry Gyroscope, Minneapolis-Honeywell, Arma, and others.

At this point it is apparent that there are really three different viewpoints on the unionization of engineers. On one hand are those who oppose unions of any kind for professionals. Those favoring unions are divided into two camps; those who desire unions affiliated with the national trade unions and those who prefer unions consisting exclusively of professionals, unassociated with any other labor organization. The key question involved here is the professional integrity of the engineer—is it threatened by membership in a union?

The Anti-Union Viewpoint

Leading the fight against engineering unions have been the professional societies. They maintain that membership in a union is inconsistent with the professional ideals of the engineer and scientist. Professional workers are not in sympathy with the usual methods of unions, such as coercion, strikes, picketing, etc. Unions tend to pull all members down to the same level, discouraging individual effort, loyalty, and ambition. The sub-average worker may benefit but the above-average will suffer. Unionization emphasizes wages, hours, and union membership instead of quality of service. The professional's work cannot be measured from the standpoint of time; hence, work and hours cannot be rigidly specified as with an hourly worker. The professional's salary should be based on ability and competence. Furthermore, if he has a problem or complaint, he is free to speak to his supervisor at any time on a dignified basis, without being reinforced by hundreds of his fellows.

The professional is more closely allied with management than with labor, and he occupies a position of trust and confidence between capital and labor. He rejects the doctrine of class conflict which is essential to unionism and realizes that more progress can be made by cooperation than by strife. It is more difficult for management to discuss confidential information with its engineers if such information could later be used by the union for propaganda or bargaining purposes. A strike by professionals greatly damages their prestige in the eyes of the public.

Most professionals are not favorably inclined toward unions. A survey taken several years ago by the American Chemical Society of its members[5] showed that 73% were opposed to unionization of professional workers and only 6% were in favor, the rest being undecided or having no opinion. A survey of the members of the American Society of Civil Engineers taken in 1953[4] showed that 63% were opposed to collective bargaining for engineers compared to 24% in favor. Older members were more opposed than younger, 72% and 56% respectively.

The Pro-Union Viewpoint

Of the professionals who are in favor of collective bargaining, an overwhelming majority prefer a professional union to one affiliated with a trade union. However, this has not deterred the trade unions from attempting to recruit engineers. One of the biggest arguments in favor of unions is the fact that the engineer has been steadily losing economic status compared to labor. Also, the salaries of engineers increase more slowly with experience than do the salaries of employees in other fields. J. B. Carey, CIO secretary-treasurer, points out[2] that in 1949, the average starting salaries for college graduates were as follows: engineers, $274; commerce, $263; liberal arts, $254. Five years later the average monthly salaries for this group had risen to: engineers, $607; commerce, $666; liberal arts, $679. Carey concludes from this that the engineers need a union, although he does not say whether the commerce and liberal arts graduates are union members.

Figures taken from the Bureau of Labor Statistics and plotted by the Seattle Professional Engineers Association in 1952[1] show that engineers are losing ground in purchasing power, especially older engineers. Taking the median wage for skilled labor (building trades) as a reference, the figures show that in 1941 an engineer with 15 years experience got 1.95 times the pay of the skilled laborer, while in 1951 an engineer with 15 years experience got 1.25 times the skilled laborer's pay, a drop of 35%. The engineer of 5 years experience received slightly less than the laborer. Purchasing power has declined 25% over this period for engineers with 10-15 years experience, although no drop is noted for beginning engineers. There have been many cases where an engineer of one year's experience was paid less than recent college graduates in the same company. However, the American Chemical Society claims that, according to a salary survey they compiled this year[6], the increase in average salaries of its members since 1941 has more than kept pace with the rise in the BLS Cost of Living Index.

The trade unions maintain that engineers are more closely allied to labor than to management and therefore rightly should join the same union as other workers in their plant. They point out that, in spite of the increase in number of technically-trained executives, the vast majority of engineers never become part of management, but remain employees all their lives. The professional societies, which have led the fight against unions, are dominated by college professors and engineering executives. Consequently, their opinions will be those of management, not of the employee-engineer. The societies have, in general, remained aloof from discussions of professional wages and, if the engineer expects to make any real improvement in his economic status, he must turn to the labor unions who have had much experience in the field of collective bargaining. So say the unions.

The labor unions have been able to recruit some engineers. The United Auto Workers represent about 50% of the engineers at Chrysler and smaller percentages at other automobile plants, although not Ford and General Motors. The CIO steel and electrical workers include some engineers. The AFL's operating engineers include some civil engineers, chiefly in Ohio and California. During the construction of the Ohio Turnpike this union was able to force some civil engineers working for turnpike contractors into the union by threatening to strike. But by and large these inroads represent only a small fraction of the more than 400,000 engineers in the United States.

ESA Attitude

The professional union attitude is perhaps best typified by the Engineers and Scientists of America group. Recognizing that the basic orientation of the engineer is pro-management and anti-union, the union has no intention of affiliating with a labor union and believes it can operate most effectively if it consists exclusively of non-supervisory professionals. The union admits that there probably will never be any need for a collective bargaining setup in a small company where there is a close, informal relationship between supervisors and employees. But in a large company where there may be hundreds of engineers working together, the individual often feels "lost in the crowd," there is little real contact with management, and feelings of professionalism are pretty well stifled. ESA has thrived in industries which mushroomed during World War II and which hire large numbers of engineers.

The decline in economic status compared to labor mentioned before has been a major source of dissatisfaction. As one engineer who favored unionization put it, 'We have leaned on our mythical professional status until my white collar is frayed. I want economic status, too." Other causes of complaints which the unions have attempted to correct are: no pay for overtime work, too little personal recognition by supervisors, the use of engineers for semi-technical jobs, lack of planning for develop-

(Continued on page 46)

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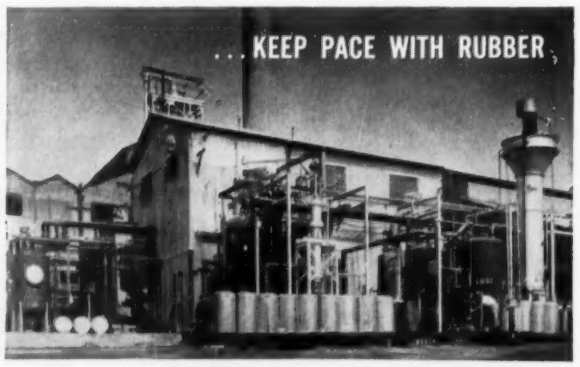

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STRESS & STRAIN IN THURSTON KIMBALL

by

Alan S. Rosenthal, E.E. '60

The Pressure Vessel Research Committee, a subcommittee of the Welding Research Council, has recently sponsored extensive investigations of local stress concentration in pressure vessels. Professor P. P. Bijlaard has made a theoretical study of the stress conditions near fittings and pipes attached to cylindrical pressure vessels. Professor E. T. Cranch conducted a series of tests to verify the theoretical work and supply further experimental data.

The need for more knowledge concerning the stresses in pressure vessels has become urgent because of the recent demand for unconventional vessels. The field of nuclear power has confronted the pressure vessel designer with pressure, temperature and weight requirements far beyond the realm of previous experience.

The stress conditions in uniform cylindrical tanks with ordinary end closures are well known. However, when pipes of various sizes pierce the shell wall or supporting members are welded to the tank they create local regions of relatively high stress. The experimental investigation determined the characteristics and magnitudes of these local stresses. The experimental results corroborated the theoretical calculations of Professor Bijlaard.

The full scale test vessel is a ⅝-inch thick steel tank, 10 feet long, and 4 feet in diameter. Five fittings of various sizes were welded to the vessel perpendicular to the cylindrical surface. A special supporting frame was fabricated by the American Bridge Company. It was fastened to the walls of the Thurston test bay thus utilizing the unique features of this laboratory.

Staff Photo

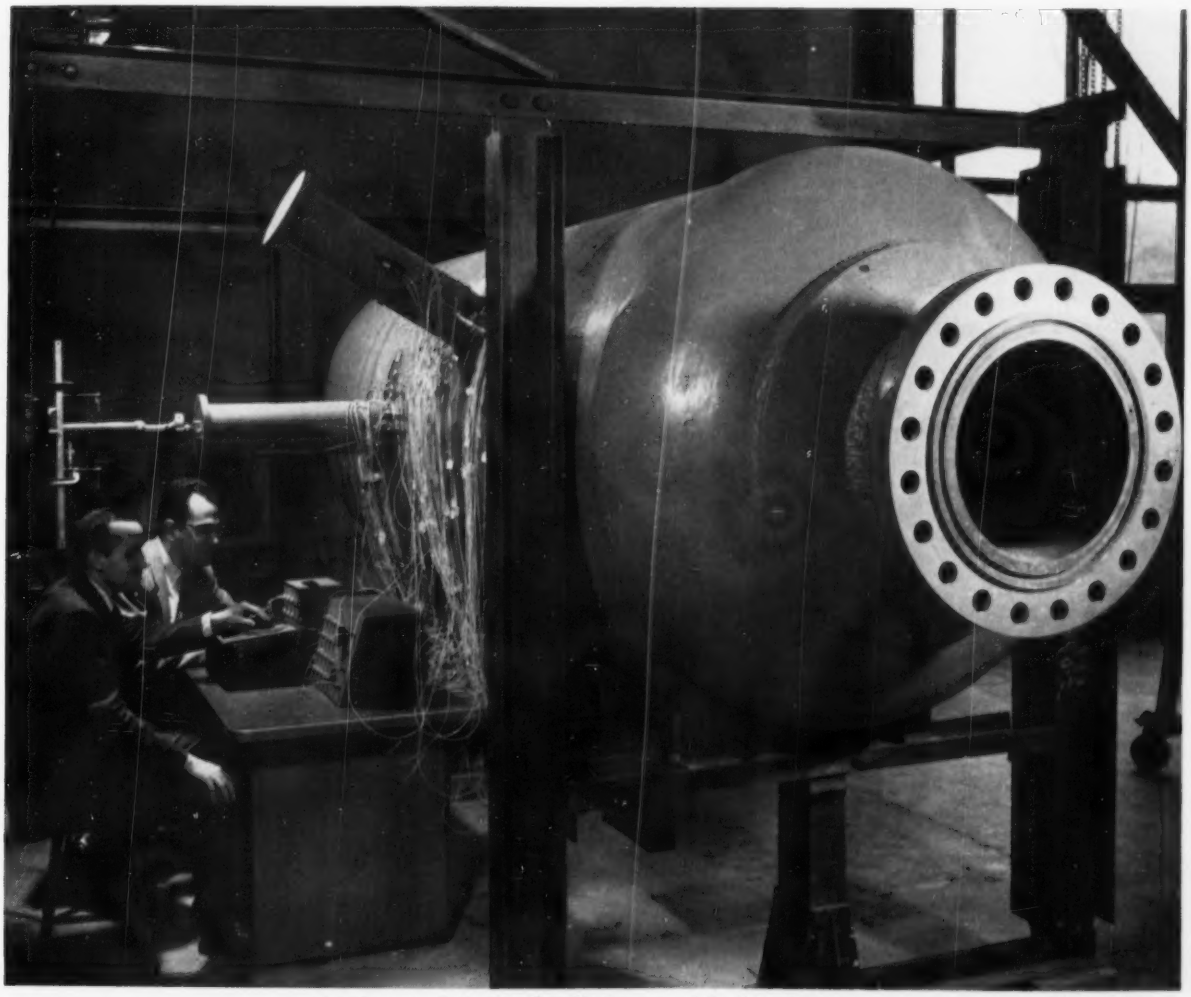
Professor E. T. Cranch, director of the pressure vessel project. With the help of a number of graduate assistants, Professor Cranch hopes to determine the strength required of a vessel subjected to the forces of high pressure fluids entering through fittings.

Types of Loads Applied

Three types of external load were applied to each fitting (1) an inward radial force (2) a longitudinal couple and (3) a circumferential couple. Each load was applied with and without internal pressure. Thus, a total of thirty individual runs were made. As a result of these combinations, a large variety of practical situations were simulated.

In the neighborhood of each fitting, a large number of "SR-4" electric strain gages were fastened to the shell with a special moisture and oil resistant cement. Opposite each external gage a similar gage was fastened to the inside shell surface. Hence, the internal gages were in contact with the dielectric oil which was used to obtain the internal pressure.

The wires from the internal gages were fed through thermocouple glands. These glands are constructed such that five wires can be brought out of a pressurized vessel without any leakage occuring. A total of over five hundred gages were installed.



A test run to determine the effectiveness of the "SR-4" gauges. Photo Science

The Welding Research Council was awaiting the results of these tests, for the information could be put to immediate use by the member companies of the Council. Knowledge of these local stresses is vital to successful design of pressure vessels. The Bureau of Ships of the U.S. Navy is presently sponsoring further theoretical work by Professor Bijlaard on the local stresses in spherical pressure vessels.

Research in Dynamic Loading

Another Kimball Thurston project involving stresses and strains is being carried on by Professor A. L. Ruoff. Dr. Ruoff's work has dealt, specifically, with dynamic loading. His research has consisted of two phases. The first project involved the investigation of the effect of sudden forces on columns, and the second dealt with the development of methods for the simultaneous application of several of these forces to beams.

In the first research project, Dr. Ruoff and his assistants applied forces to columns in order to observe the effects predicted by Euler's theory, a hypothesis developed in the eighteenth century. According to this theory, one should be able to calculate the manner in which a column will buckle knowing its elastic modulus, cross section, length, and the force being applied.

When a column is subjected to a force it may, theoretically, buckle in an infinite number of ways depending upon the force applied and how rapidly these are applied. Usually a column will buckle in the "first mode" which is nothing more than a "C" shaped bend. If, however, a large force is suddenly applied and then quickly removed, the column will buckle in the "second mode." The characteristic deformation of the "second mode" is an "S" shaped bend.

When a column is deformed into the "second mode," it retains its "S" shape for a very short period of time. In order to see the curve, Dr. Ruoff used a high speed movie camera. The movies provide, as far as we know, the first actual view of a column being bent in the "second mode." The observed data verified Euler's theory as was expected.

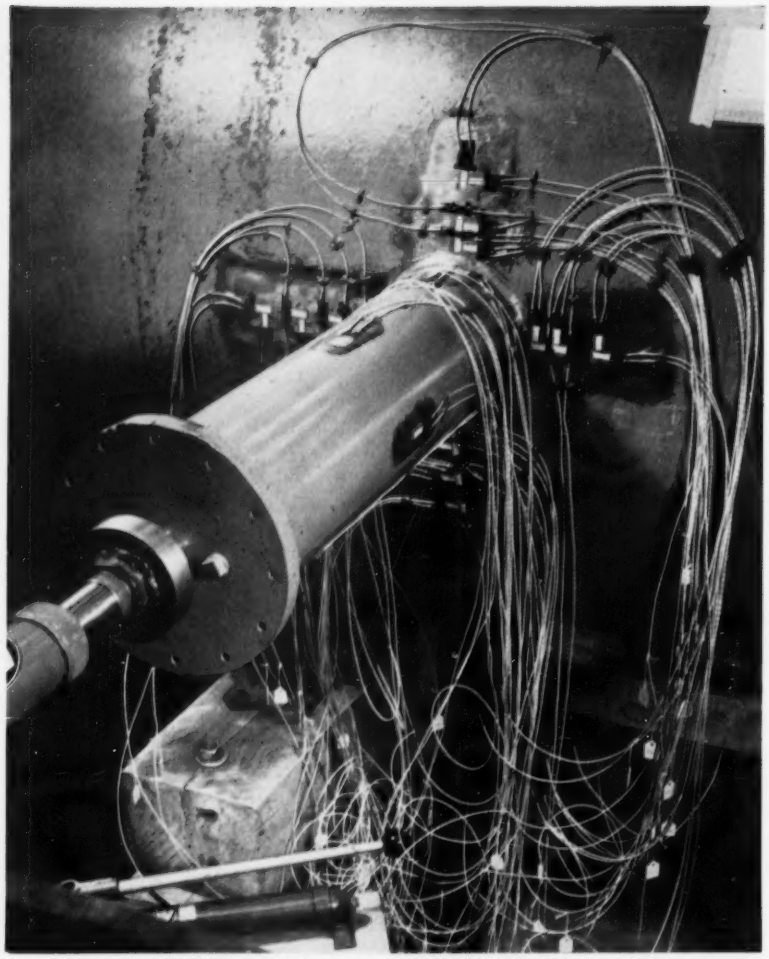
"Bomb" Used in Experiment

In order to apply the required thrust to the column, the investigators employed a "bomb," which consists of a chamber into which an explosive is inserted. A piston fits into the chamber above the explosive. When the "bomb" is detonated, the piston moves upward with a tremendous force; however,

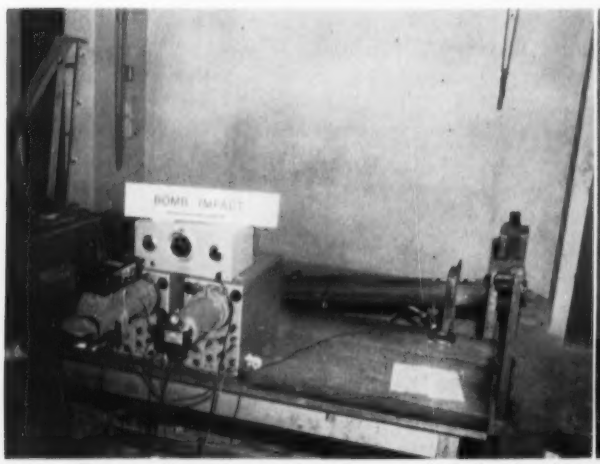
another chamber is inverted above the first so that after the piston's force is transmitted to the column, the force can immediately be removed.

It is the investigation of these "bombs" with which Dr. Ruoff and his group, K. Foster, J. Weese, D. Link, M. Zabat, R. Foy, and F. Frank, are concerned. Originally under the direction of Professor D. A. Stuart, the project is part of the investigation being carried on by the United States Navy to discover the effects of large shocks on different structures. A large part of this research is being carried out by the Applied Physics Laboratory of Johns Hopkins University.

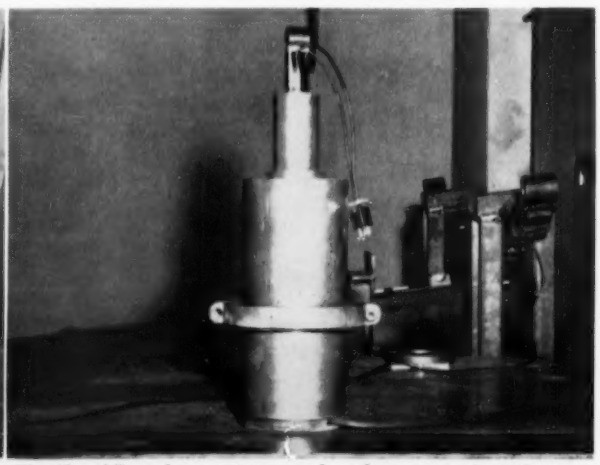
The object of Dr. Ruoff's experiments is to develop a method that will enable a number of "bombs" to go off simultaneously. It is necessary to have a large force applied to structures that are being tested in order to simulate the shock waves created by atomic and hydrogen weapons. In order to develop a simultaneous explosion of the "bombs," Dr. Ruoff has set up two of the devices beneath a beam that is free to move to a limited extent in one direction. To each of the "bomb" piston rods, the professor has attached "SR-4" gauges. The gauges are connected to two oscilloscopes through the use of a "Wheatstone bridge" hook-up. One of the oscilloscopes records the differences between the two strains developed in the "bomb" piston rods while the other records the strain in one of the "bomb" piston rods. By observing the resulting shock patterns, the investigators can see the precise instant at which the devices go off. Professor Ruoff and his assistants have succeeded in bringing the instants during which the forces are applied from three to five milliseconds apart. Their current goal is to have the "bombs" go off within one millisecond of each other. When this is accomplished, research workers will have a valuable aid in the investigation of the effects of shock waves on building structures.



One of the vessel's fittings completely rigged with gauges. Photo Science



An oscilloscope shows the precise instant at which the "bombs" fire. Staff



The "bomb" used to exert tremendous forces at a given time on an object. Staff

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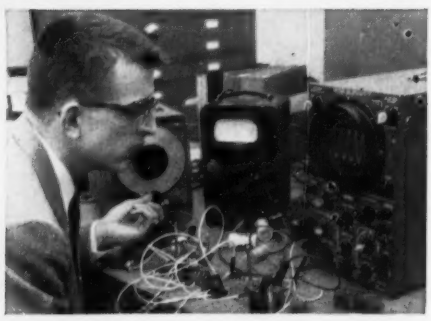


Pratt & Whitney Aircraft engineer checks a bread board model for a subminiature, encapsulated amplifier built with transistors.

A rig in one of the experimental test cells at P & W A 's Willgoos Laboratory. The six large finger-like devices are remotely controlled probe positioners used to obtain basic air flow measurements within a turbine. This is one of the techniques for obtaining scientific data vitally important to the design and development of the world's most powerful aircraft engines.

. . . in the field of INSTRUMENTATION

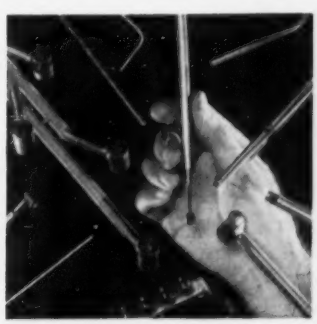
Among the many engineering problems relative to designing and developing today's tremendously powerful aircraft engines is the matter of accumulating data — much of it obtained from within the engines themselves — and recording it precisely. Such is the continuing assignment of those at Pratt & Whitney Aircraft who are working in the highly complex field of instrumentation.

Pressure, temperature, air and fuel flow, vibration — these factors must be accurately measured at many significant points. In some cases, the measuring device employed must be associated with special data-recording equipment capable of converting readings to digital values which can, in turn, be stored on punch cards or magnetic tape for data processing.

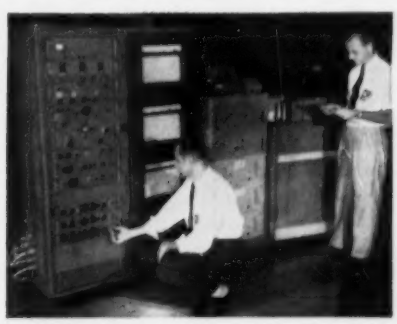
Responsible for assembling this wealth of information so vital to the entire engineering team at Pratt & Whitney Aircraft is a special group of electronic, mechanical and aeronautical engineers and physicists. Projects embrace the entire field of instrumentation. Often involved is the need for providing unique measuring devices, transducers, recorders or data-handling equipment. Hot-wire anemometry plays an important role in the drama of instrumentation, as do various types of sonic orifice probes, high temperature strain gages, transistor amplifiers, and miniaturized tape recording equipment.

Instrumentation, of course, is only one part of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of combustion, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.

Instrumentation engineer at Pratt & Whitney Aircraft is shown investigating modes of vibration in a blade of a single stage of a jet engine compressor.



Special-purpose probes designed and developed by P & W A engineers for sensing temperature, pressure and air flow direction at critical internal locations.



The "Plottomat", designed by P & W A instrumentation engineers, records pressure, temperature and air flow direction. It is typical of an expanding program in automatic data recording and handling.

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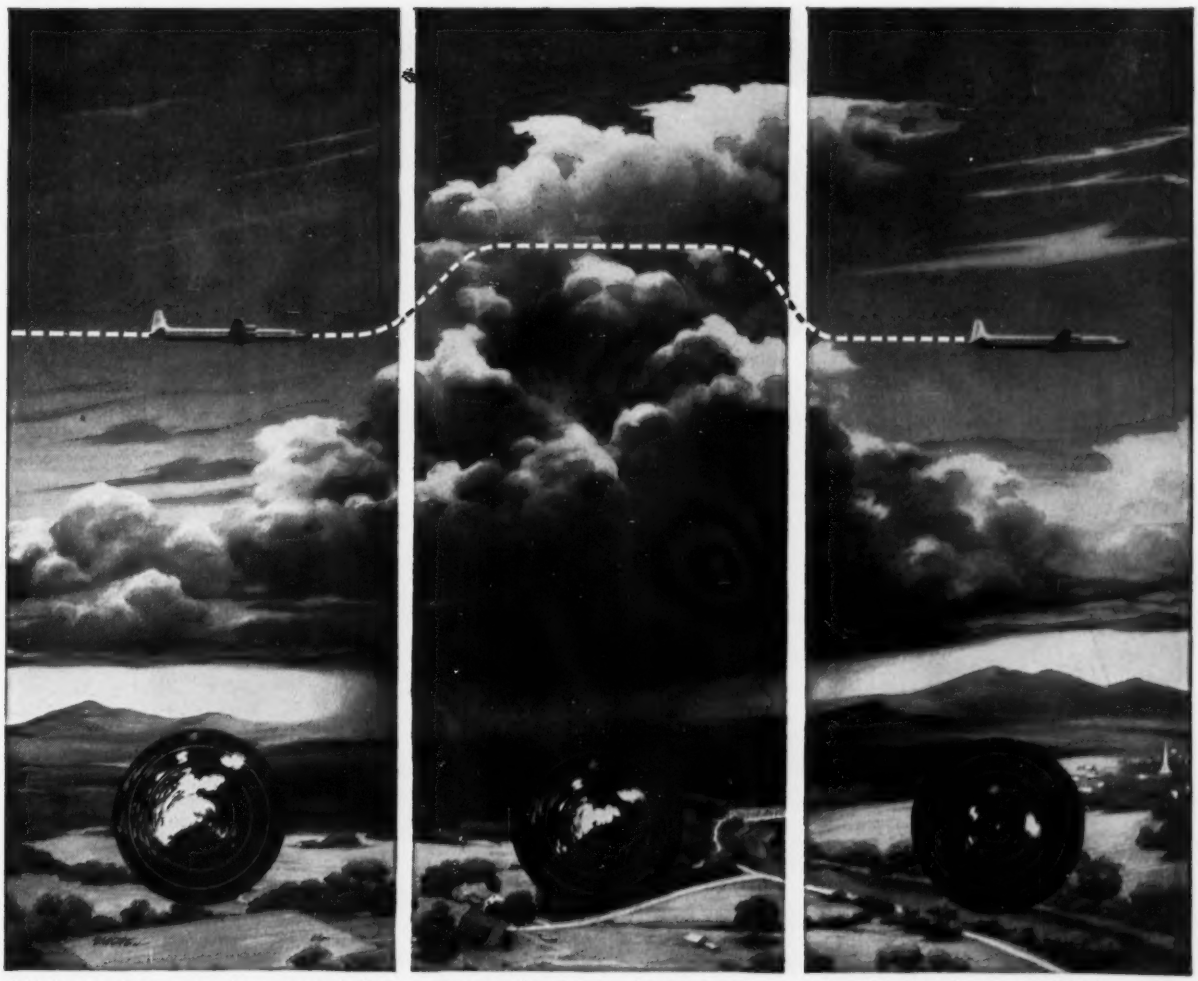


RCA Weather Radar screen shows approach of storm. Screen guides pilot around turbulent area. All's well as plane leaves storm behind.

How RCA Weather Radar adds comfort and speed to your flight

No longer need you, as a traveler of the sky, experience the discomfort of bouncing around during storms. If your plane is equipped with RCA Weather Radar, you enjoy comfort and speed throughout.

For supersensitive RCA radar peers miles ahead of the plane to give your pilot advance warning of weather disturbances. The signals on its screen then point the way to a smooth course around storm areas.

The electronic leadership behind Weather Radar is inherent in all RCA products and services. And at the David Sarnoff Research Center of RCA, Princeton, N. J., scientists continue to explore new "Electronics for Living"—electronics that make life easier, safer, happier.

WHERE TO, MR. ENGINEER?

RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

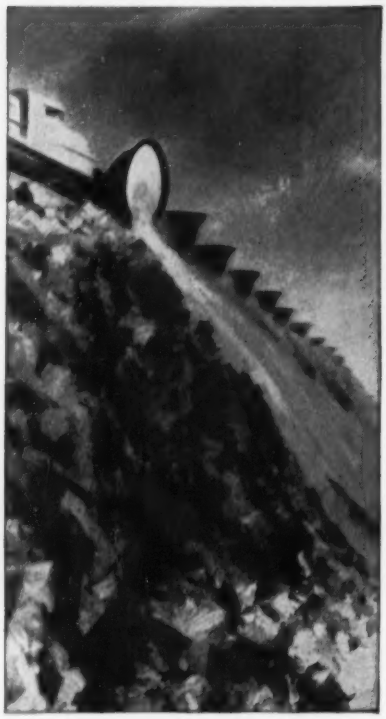
LEADING AIR LINES installing RCA Weather Radar include American Airlines, Continental Air Lines, Pan American World Airways, Trans World Airlines Inc., United Air Lines; and these European Air Lines: Air France, BOAC, Iberia Air Lines of Spain, Sabena Belgian World Airlines, Swissair, Mexicana.

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

Inco Nickel Progress Report

How Inco's more-from-the-ore research program is expanding North America's natural resources



Once the iron in Nickel-containing pyrrhotite went to slag heaps.

Now this high-grade iron ore—product of Inco research—goes to steel mills. Here you see it being fed into open hearth furnaces.

Now Inco saves iron in Nickel ore from the slag heap

ALSO RECOVERS NICKEL

There's iron in Nickel ore.

But for years, this iron was of no commercial value. No one could find a way to recover it.

Recently, after years of research, International Nickel pioneered a new extraction process.

Saves the iron—

Nickel is recovered, too!

This new Inco process not only recovers iron ore from pyrrhotite *economically;* it is the highest grade iron ore (68% iron) now produced in quantity in North America. It also recovers the Nickel in the ore.

For its pioneering new process, International Nickel has built a $19,000,000 recovery plant. Modern and streamlined, this plant is only the first unit of the new Inco Iron Ore operation. It is expected to add hundreds of thousands of tons a year to this continent's high-grade iron resources.

More from the ore

That's one of the prime objectives of International Nickel's expansion program. As in the case of iron ore, this has enabled Inco to expand the free world's natural resources. Today, International Nickel gets fourteen different elements from its Nickel ores.

• • •

"Mining For Nickel"

Inco's new full-color, sound film! 16mm prints loaned to engineering classes and student technical societies. The International Nickel Co., Inc., Dept. 127e, New York 5, N. Y.

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HOTEL ENGINEERING

by

Stephen S. J. Hall, Hotel '56
Engineer, 31st Hotel Ezra Cornell

"The engineering of today determines the success of tomorrow." With each day the validity of this statement is brought more and more into realization. Not only do the fields of science and manufacturing realize the importance of engineering, but the field of hotel management as well. In its role as the seventh largest industry in the United States, the hotel industry, each year, spends many millions of dollars in an attempt to stay abreast of today's engineering trends.

Contrary to the thoughts of many, the hotel of today is not merely a nest of rooms with hot and cold running water, but a complex—to use a much overworked cliche—"City within a city." Few other installations can ever attempt to attain the variety of engineering which is present in varying degrees from the small 100 room hotel to the 3000 room transient skyscrapers of our century. To give some idea of the magnitude of a large hotel, let us look at the Palmer House. Built in Chicago in 1873 and rebuilt 1925, it contains some 23.5 million cubic feet of space. Its total floor area numbers 2 million square feet, or the equivalent of 2000 average 5 room houses. Corridors alone measure a total of 3 miles, and there is enough glass in the windows to cover an area 3½ acres large. If the electrical wiring were stretched out in a continuous line, it would circle the earth at the equator.The telephone accommodations alone could service a city of 35,000, and the laundry done each day is equivalent to that of a town of 5,000. Only one of the hotel's many facets is the manufacture of its own furniture within the hotel itself. There is as much food refrigeration in the Palmer House as there is in 20 large supermarkets. Ten theaters could be air conditioned by the equipment in this one hotel. The Palmer House manufactures its own electricity, and heating and ventilation. To find someone capable of coordinating this immense maze of engineering the hotel has been willing to pay as much as $20,000 annual salary to its chief engineer. In spite of this magnitude of annual income, few engineers aspire to the position of hotel engineer.

Wide Variety of Engineering Subjects Required

We, of the school of Hotel Administration, in order to keep our school in its present position as the world's best formal hotel education, and to keep ourselves abreast of the trends of tomorrow, find a wide variety of engineering subjects as required parts of our curriculum. In fact, cognizant with our basic studies in accounting, foods, economics, personnel, and law, we must include 15 hours of engineering studies in order to qualify for diploma. These are chosen from among a possible 27 hours of engineering studies which include mechanical drawing, refrigeration, heating and air conditioning, water systems, electricity, building construction, food service design, hotel planning, and special equipment. Of course, upon the completion of the study of the basic facts in each subject, the nature of the subject is approached as through the eyes of the hotel manager. For example, Mechanical Drawing and Design includes the layouts of coffee shops, front offices, lobbies, cafeterias, and motels. Special Equipment deals with the problems of central vacuuming, fire protection and alarms, laundry design and operation, communication systems, machine shop equipment, kitchen equipment, and engineering reports and organization.

Laboratories are generally taught by student instructors who are drawn from the top ranks of the hotel school, engineering school, and the school of architecture. It is felt that the student learns more quickly when guided by someone who shortly before faced many of the same problems. Laboratories are kept small, generally from 4 to 8 students per 2½ hour period. Formal instruction is taught by a staff of 3 professors who are specialists in various phases of hotel engineering. They, of course, are graduate engineers with many years of experience not only in the field, but in education as well.

Why Hotel Students Take Engineering Courses

Probably of more interest to the professional engineer than what

the hotel school teaches is the question of why? Graduates of the School of Hotel Administration have no intentions of becoming proficient in the field of engineering. We hope only to learn the underlying principles, plus a working knowledge of the terminology, and a few basic facts of trouble shooting. For that reason, we have slanted our instruction towards the practical applications rather than the theoretical understanding. The school is trying to impart to the potential hotel manager the importance and magnitude of the engineering problem. For example, recently one large hotel contracted for the air conditioning of some 1250 of its rooms, at a contract price of $1,250,000, which represents nearly ½ of the hotel's annual operating profit. Professional engineers planned and supervised the installation, however, only after a thorough study of the problem by the hotel manager and staff, who then issued the construction order. Air conditioning is a problem faced today by all except the newest hotels. Perhaps the largest single engineering problem is that of renovation to overcome obsolescence. Design to decrease the heavy burden of labor cost and turnover is another problem in today's hotel. The current trend of the public to travel by auto has put pressure on the hotel design if it wishes to compete with the motel. These are only some of the many problems present in existing hotels, and these say nothing of the new metropolitan hotels, motor hotels, and food service installations which are planned or under construction at present.

These projects require competent and experienced engineers, a fact which unfortunately many of today's hotelmen do not realize. The underlying principle of hotel engineering is to hire competent professional engineers, or consultants whenever major projects are to be undertaken, and to work together with them for the ultimate in professional theory and practical application. Hotel Administration graduates do not expect to know the engineering profession, nor do they expect the engineer to know the hotel profession. Recently, one concern found itself faced with a renovation costing several thousands of dollars—actually 2½ times more than the original installation —because the original design was not thought out thoroughly enough along the lines of theory versus practicality. Hotel students are taught to realize the importance of, and to place their faith in today's professional engineer, and by studying briefly the problems of engineering, it is felt that they can achieve a small working knowledge of the subject which will result in a more thorough, superior design, at a decreased cost. By working together with the engineer, the hotel manager of tomorrow wishes to eliminate the unnecessary and inefficient work which can result from an engineer not understanding hotel problems, and a hotel manager failing to understand those of the engineer.

. . . . CORNELLIANS . . . .

We join the ENGINEER in welcoming you once more to Cornell. We're as old as the Class of 1903 and as new as the Class of 1960. During the past summer the Triangle changed hands—but not hearts—and we're ready to serve you another half century—at least!

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The store with the 10% dividends.

You'll enjoy trading at the
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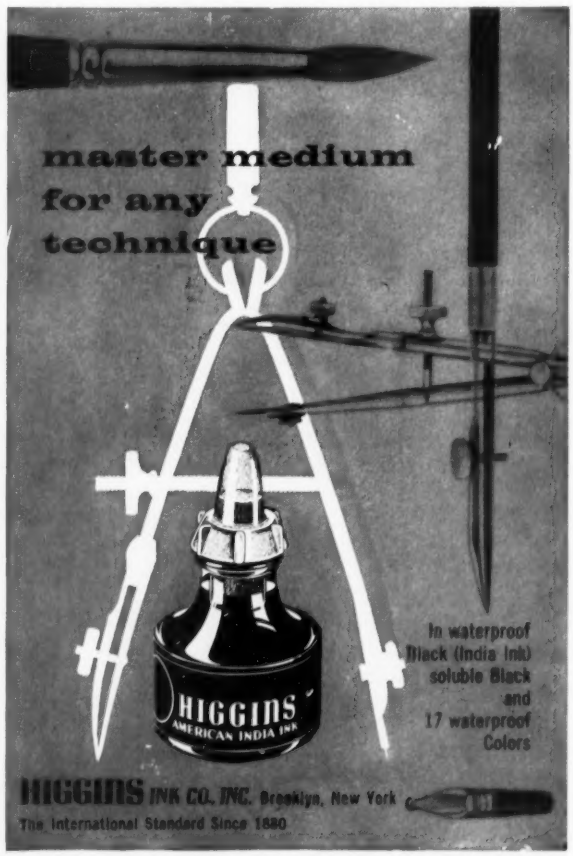

College graduates in growing fields...
growing with UNION CARBIDE

IN ATOMIC ENERGY...

"I'm Class of '52, with a B.S. in chemistry. I wanted to do research in the atomic energy field, so I went to work at Oak Ridge National Laboratory, which Union Carbide Nuclear Company operates for the AEC. After two promotions I'm an Associate Chemist, doing research in special materials important to the atomic energy program."

IN CHEMICAL ADSORBENTS...

"I'm a chemical engineer, Class of '53. Two years after I joined Linde Air Products Company I was in charge of a group of engineers and technicians synthesizing Molecular Sieve adsorbents. I recently transferred to a Development group exploring applications of these new adsorbents, and have many opportunities to help LINDE customers with their problems."

IN AUTOMATIC PRODUCTION...

"I'm an electrical engineer, Class of '53. I joined National Carbon Company, and after a short orientation worked on problems of instrumentation of automatic equipment for the production of batteries. Now I'm assistant head of the Product and Process Control Lab., working in product development with full responsibility for inspection and quality control."

IN PURCHASING...

"I received my B.S. in Chemical Engineering in '51 and my Masters in Business Administration in '54. I went to work for Union Carbide, and after a year of training at plants all over the country, I transferred to New York as a Purchasing Agent, responsible for contract negotiations and cost reduction in the purchase of heavy chemicals."

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If you are interested in a future in production, development, research, engineering, or technical sales, check the opportunities with any Division of Union Carbide. Get in touch with your college placement officer, or write directly to:

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A DECISION-MAKING LETTER

THAT COULD BE VERY TRULY YOURS

Mr. Matthew Stepanski
Industrial Relations Director
The Heald Machine Company
Worcester 6, Massachusetts

Dear Mr. Stepanski:

I'm glad to say that I've finally arrived at the decision to join the Heald organization. It's quite a problem to make just the right choice.

You may be interested to know that one of the things that attracted me most was the prospect of associating with a company of just-the-right-size, offering the opportunity for personal growth in a permanent engineering career. The nature of your expanding industrial markets in the precision-finishing machine tool field, your carefully planned training schedule, the far better-than-average benefit programs and especially the kind of Heald people I met in my visits to Worcester weighed heavily in your favor, too. Of course the opportunity of real living in an excellent geographical area was another factor not to be overlooked. But it was the overall picture which made me feel that Heald was the place for me - and for my family.

Thanks again for helping me to plan my future. I look forward to starting work with you as soon as is mutually convenient.

Very truly yours,

For information on sales, engineering and manufacturing opportunities at Heald, see your placement director, or write to Matthew Stepanski, Industrial Relations Director, The Heald Machine Company, Worcester 6, Massachusetts

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Former Director

Dr. CHARLES R. BURROWS

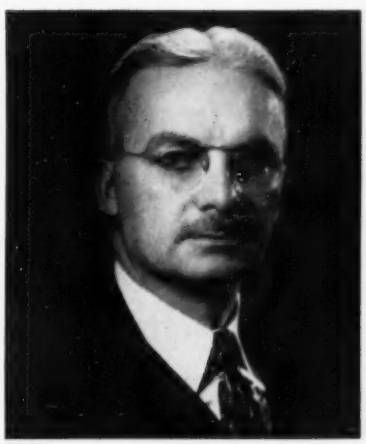
by

Peter Bowman, EE '60

Since the first of July Cornell has been without the services of one of its most colorful and famous faculty members. Dr. Charles R. Burrows, internationally known scientist and Director of Cornell's School of Electrical Engineering, left at that time to become Vice-President for Engineering at the Ford Instrument Company, a division of the Sperry-Rand Corporation.

In his new capacity, Dr. Burrows will head all engineering, development and research for an organization which has wide-spread activities in the field of missile guidance, radio propagation, advanced aircraft instrumentation and other activities in electronics and computers. Dr. Burrows will personally direct plans for this country's first closed-cycle gas turbine nuclear reactor, which has valuable applications in the fields of propulsion and municipal power production. It will also be his responsibility to organize and co-ordinate those departments of the company under his supervision, so that they can be best put to use in the company's rapid expansion. He will report directly to the president as a consultant on these matters. (The president of Ford Instrument, Raymond F. Jahn, is a graduate of Cornell, class of 1923, from the School of Mechanical Engineering.)

Dr. Burrows' achievements during his years at Cornell, as well as in the preceding period, are numerous and many of them are of major importance. At one time, he was Associate Chief Scientist of the General Electric Company's Advanced Electronics Center, and before World War II, he worked on the proximity fuse and on the development of radar and countermeasure equipment. During the war, he was chairman of the radio wave propagation committee of the National Research and Development Council, which co-ordinated all research work in this field, and for this he received the Presidential Certificate of Merit. Dr. Burrows was also a research specialist for the Bell Telephone Company for twenty-one years, during which time he obtained several patents. From 1946 to 1954, Dr. Burrows was president of the Joint Commission of Radio Meteorology of the International Council of Scientific Unions and for a period of six years, he was head of its committee on tropospheric propagation of electromagnetic waves. At the moment, he is vice-president of the International Scientific Radio Union and is a past president, fellow and director of the Institute of Radio Engineers.



Dr. Charles R. Burrows, former director of the School of Electrical Engineering

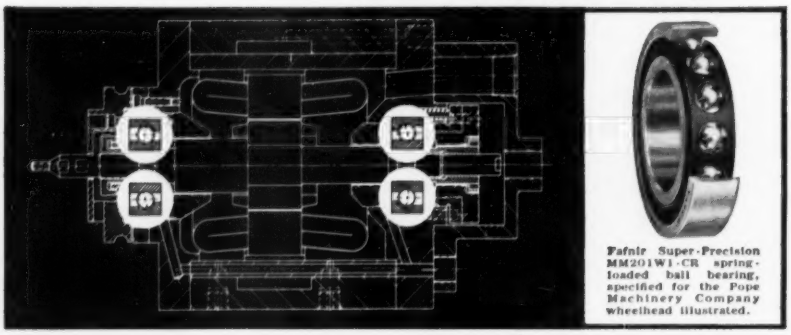
Dr. Burrows is a graduate of the University of Michigan, where, in June 1924, he received the bachelor of science degree in electrical engineering, and in 1935 his professional degree in that field (equivalent to a Ph.D.). Columbia University awarded him the Master of Arts Degree in 1927 and a Ph.D. in physics in 1938. Dr. Burrows is a member of Sigma Xi, Tau Beta Pi, Eta Kappa Nu, The American Institute of Electrical Engineers and the American Physical Society.

Under Dr. Burrows' direction, the School of Electrical Engineering at Cornell has come a long way forward in the years following his arrival here in September of 1945. Eleven years ago, graduate research activity at Cornell was practically non-existent, the school was housed in old Franklin Hall and the curricula needed revision to enable the school to keep up with the rapid developments taking place in the fields of electricity. Today the picture is much brighter. The three to four thousand dollars spent annually on research has enabled Cornell research workers to develop an explanation of what is known as the "scatter propagation" of radio waves, one of about seven major developments in the field of electronics in recent years. Large scale work is being devoted to an examination of the common vacuum tube to determine its causes of failure, the solution to which is of

vital importance to our armed forces. In particular, great strides have been made in improving the School of Electrical Engineering laboratory facilities. The addition of the servo-mechanism and digital computer, as well as the installation of the giant AC network calculator for the solution of power system problems and the similar fluid non-linear calculator for water systems, has made it possible for Cornell to offer courses of study which few other schools can equal. And then, of course, Cornell can boast of its beautiful but at the same time extremely functional Phillips Hall. Cornell has benefited not only from Dr. Burrows' achievements in improving the School of Electrical Engineering, but also from the wide-spread fame of his accomplishments, which have taken the name of Cornell throughout the world.

OVER 14 BILLION REVOLUTIONS

. . . and still going strong



Fafnir Super-Precision MM201WI-CR spring-loaded ball bearing, specified for the Pope Machinery Company wheelhead illustrated.

This Pope-built motorized grinder wheelhead, equipped with its original Fafnir Super-Precision Ball Bearings, has totaled over 14 billion revolutions, operates at 72,000 rpm. Used for grinding the races of extra-precision ball bearings, this wheelhead is still in production-line service.

Fafnir engineers worked with Pope Machinery Company in selecting bearings for this high-speed wheelhead. The specification of Fafnir ball bearings plus their remarkable record of performance, demonstrates how Fafnir keeps pace with machine tool progress . . . and why more and more engineers look to Fafnir for help with bearing problems. The Fafnir Bearing Company, New Britain, Conn. (23 Branch Offices)

The Fafnir Bearing Company consists of six plants — all located in or near New Britain, Connecticut. Manufacturing space (including a new instrument bearing division) totals more than 1,250,000 square feet.

Backed by the extensive production and research facilities of a company recognized as one of the foremost in its field, Fafnir engineers have enjoyed a long-standing reputation as bearing experts serving not just one or two, but all fields of industry.

Perhaps Fafnir offers you the opportunities you want in engineering and sales engineering. We'd be glad to hear from you.

FAFNIR BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

Unionization . . .

(Continued from page 28)

ment of young engineers to increase their effectiveness, failure to maintain professional standing and dignity, inadequate channels of two-way communication, inadequate and undesirable offices, lack of secretarial and drafting assistance, and punching the time clock.

Due to the employment of large numbers of scientists and engineers, there has been a strong tendency towards specialization and standardization of work. The individual engineer now has little control over his work done, economic status, and advancement. The professional, therefore, needs a group to speak for him. He has turned first to his professional society but they have not met his needs due to their reluctance to discuss salaries. In any case the societies could not collectively bargain since, in order to be certified by the NLRB, they must be free of employer influence.

The professional unions believe they have met the challenge without sacrificing professional dignity. They have: encouraged membership in professional societies, striven to collectively bargain on a dignified basis, stressed merit increases for employees based on individual ability rather than seniority, maintained voluntary membership and individual freedom of action, tried not to build antagonism between employer and employee, standardized working conditions without regimenting performance. Unionism is not incompatible with loyalty to management and the unions feel that, if they can help the engineers' economic status and security, there is no need to lose respect for their profession.

As with the trade unions, the professional unions believe the power to strike is necessary as a weapon against management, although they are reluctant to use it. To be effective, the strike requires the cooperation of the trade union members within the plant; otherwise, the results on production of a strike by professionals may not show up for weeks. Recent strikes of professional and technical employees have included those at Minneapolis-Honeywell, Crane Company, Sperry Gyroscope, and Arma Corporation.

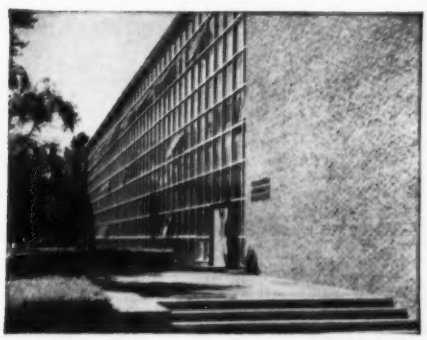
Conclusions

Ideally, unionization of engineers and scientists is probably not a good thing. Membership in a collective bargaining group does have some detrimental effect upon the individualism and professional standing of the engineers involved, the degree of such effect would depend upon the union. However, ideal situations are rarely encountered and in large companies hiring hundreds of technical employees where professional dignity has already been stifled, the professional union serves a very real need in representing the problems of its members to management. It is noteworthy that the trend, while gradual, is towards increased union membership and activity, and that this trend will probably continue. It is unlikely that the large trade

(Continued on page 59)

announcing ..... RAYTHEON GRADUATE PROGRAM

FOR STUDY AT HARVARD AND M. I. T. IN 1957-58



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The Raytheon Graduate Program has been established to contribute to the technical development of scientists and engineers at Raytheon. It provides the opportunity to selected persons employed by Raytheon, who are accepted as graduate students by Harvard or M.I.T., to pursue, at Raytheon's expense, regular courses of study leading to a master's degree in science or engineering in the institution of their choice.

The Program requires, in general, two or three semesters of study, depending on circumstances, with the summer months spent in the Company's research, engineering, or manufacturing divisions. It includes full tuition, fees, book allowances and a salary while at school. Students also receive health, accident, retirement and life insurance benefits as well as annual vacation and other privileges of full-time Raytheon employees.

To be considered for the Program, applicants must have a bachelor's degree in science or engineering, and should have outstanding student records, show technical promise, and possess mature personal characteristics. They must be under 30 years of age on September 15 of the year admitted to the Program. They may apply for admission to the Program in anticipation of becoming employees of Raytheon.

YOU ARE INVITED TO ADDRESS YOUR INQUIRY to Dr. Ivan A. Getting, Vice President, Engineering and Research, outlining your technical background, academic record, school preference, and field of interest, prior to December 1, 1956.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish closer relationship between the college and the alumni."

The Society and You

In the usual high sounding phraseology of Founders, those who started the Cornell Society of Engineers gave as the object "to promote the welfare of the College of Engineering at Cornell University, its undergraduates and graduates and to establish a closer relationship between the College and the Alumni." Just what does this mean to YOU?

For the engineering student at Cornell, from the entering freshman to the candidate for a Ph.D., it means there is a group of Alumni working for the financial support and continued growth of the College. The Society and its total resources are always available to the Dean of the College and the Directors of the various Schools for any purpose and at any time. Through established agencies, the Society assists in recommending curricula changes to more nearly reflect the needs of industry, aids in obtaining financial support through scholarships, fellowships and unrestricted gifts, and financially supports prizes for exhibits on Engineer's Day at Cornell.

For the Alumni of Cornell Engineering, from the 1956 graduate to the candidate for retirement, it means a group working for the professional advancement of all. This is accomplished through active participation in the Society affairs. Cornell engineers, through selection and training, have done well and are represented at every level of success throughout American industry. For the young graduate the Society represents a congenial meeting ground for association with such men—a place to know the men worth knowing. For the more experienced engineer and for the man "worth knowing," the Society represents a means for the leisurely exchange of ideas with fellow Alumni, and the instrument through which you can direct some of your success to the advantage of Cornell Engineering. The affairs of the Society are conducted in regional groups located in New York, Philadelphia, Boston, Chicago, Detroit and St. Louis and at the national headquarters in New York.

Let me add here a sincere and cordial welcome to the 1961 Class of future engineers. You have elected to accept training and to subsequently embark on a career in the engineering sciences. We can assure you that your training at the Cornell College of Engineering will be the best. From here on it depends on you —there will always be a wonderful, exciting future for a *good* engineer.

WALTER L. HARDY, PRESIDENT
CORNELL SOCIETY OF ENGINEERS

ALUMNI ENGINEERS

Robert A. (Bob) Hentz, M.E., Newtown, Bucks Co., Pa., took his first job with Phila. Elec. Co. and was told he would be paid 10c an hour, maybe 15. The supervisor, who happened to be a distant family relative, said: "Let's make it 15." That was the start. He got to the head of Station Electrical Design & Construction Div., and later dropped construction and took on all other electrical engineering, plus system planning. Unfortunately, a collapse in '43 brought about his retirement. "So here I am living a carefree life on a 45-acre place that was once a farm. Married my Junior Prom date in '13; one son, **Bob '38,** and 2 daughters; ample opportunity to baby-sit for 7 grandchildren."

Frank P. Rhame, M.E. '09, and Mrs. Rhame, 1440 Rogers Street, Clearwater, Fla., left June 1 for a Mediterranean cruise. They will stop over in Spain for a few months to visit their daughter and son-in-law, Lt. Col. **John E. Mitchell, Jr. '38,** Ordnance representative of the Military Assistance Advisory Group (MAAG) in Spain.

Erskine Wilder, M.E. '05, writes that he is "retiring to Florida after a lifetime in Chicago." His address is 1644 Blue Heron Drive, Sarasota, Fla.

Alexander S. Langsdorf, M.M.E. '01, A.B. '03, and Mrs. Langsdorf **(Elsie Hirsch)** '03 will celebrate their fiftieth wedding anniversary June 26. Langsdorf retired in 1948 as dean of the schools of engineering and architecture at Washington University, St. Louis, Mo. Address: 7526 Byron Place, St. Louis.

William P. Heising, Chem.E. '44, has been named manager of the New York Scientific Computing Center, International Business Machines Corp. He has been with IBM since 1950. Address: 170 Christopher Street, Montclair, N.J.

Fred L. Heisley, M.E. '48, left Goodyear Aircraft Corp. last August to join a new electronics research and development company organized by Savage Manufacturing Co. in Phoenix, Ariz. His address in Phoenix is 6809-N Fifteenth Street.

Le Roy C. Lane, M.E. '12, and Mrs. Lane of South Kent, Conn., left last November for a trip around the world by freighter.

Herman Redden, E.E. '27, is division plant manager for New Jersey Bell Telephone Co. He lives at 50 Bellvale Road, Mountain Lakes, N.J.

William C. Taylor, M.E., '23, is vice-president of American Steel Foundries, New York City. He was transferred last October from the company's Chicago office, where he was district sales manager. Taylor's address in New York City is 230 Park Avenue.

Carlyle M. (Abe) Ashley, M.E., '24, chief staff engineer of Carrier Corp., Syracuse, has been named to the important post of president of the American Society of Refrigerating Engineers.

G. Turner Wilson, Jr., Chem.E., '44, 911 Arbor Lane, Glenview, Ill., is a chemical engineer with Standard Oil Co. of Indiana. His fourth child and first daughter, Mary, was born June 6.

Burnett W. Wright, M.E., '44, is with Lockheed Aircraft Corp. in Van Nuys, Cal., where he lives at 7943 Haskell Avenue.

William C. Spiker, C.E., '00, of Mountain View, Ga., is an advisory engineer on foundations and structures. He writes that he will be eighty-four next November and expects to retire soon.

Walter Giele, M.E., '06, is a consulting engineer and general chairman of the East Coast Regional Foundry Conference to be held in Philadelphia April 12-13, 1957. His address is Box 483, Lebanon, Pa.

Harry F. LaBrecque, C.E., '07, is a retired civil engineer and now has his own consulting engineering business in Phoenix.

Edwin C. Cubler, C.E., '22, 305 Waring Road, Elkins Park, Pa., is a project manager with Raymond Concrete Pile Co., New York City. He was formerly assistant general manager of West African Constructors in Monrovia, Liberia.

Charles J. Baker, E.E., '27, 1339 Twenty-seventh Street N.W., Washington 7, D.C., is a consultant to machinery manufacturers on government and export matters. Before starting his own consulting business, he was for five years director of the machinery division in the Foreign Aid Program.

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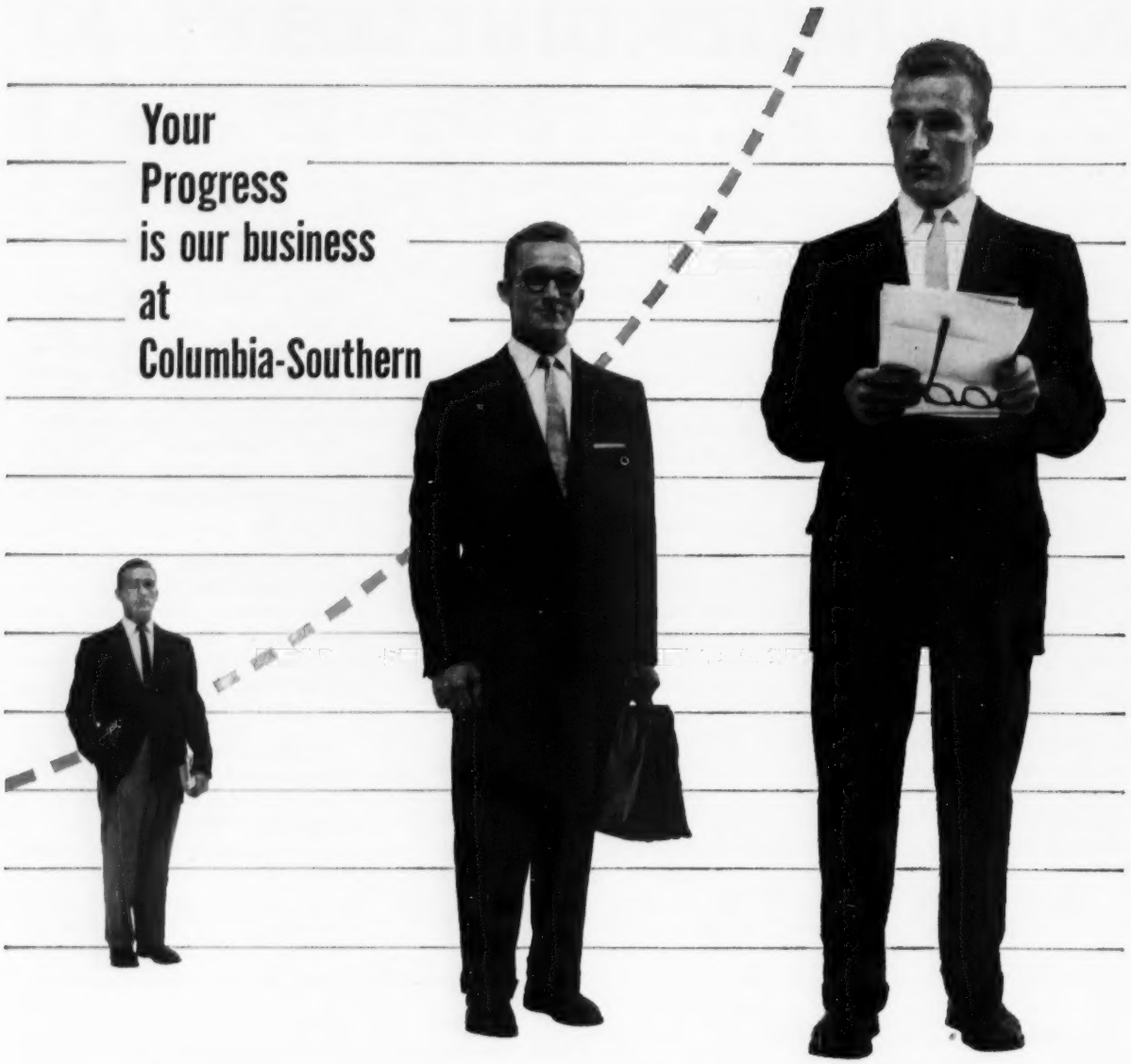

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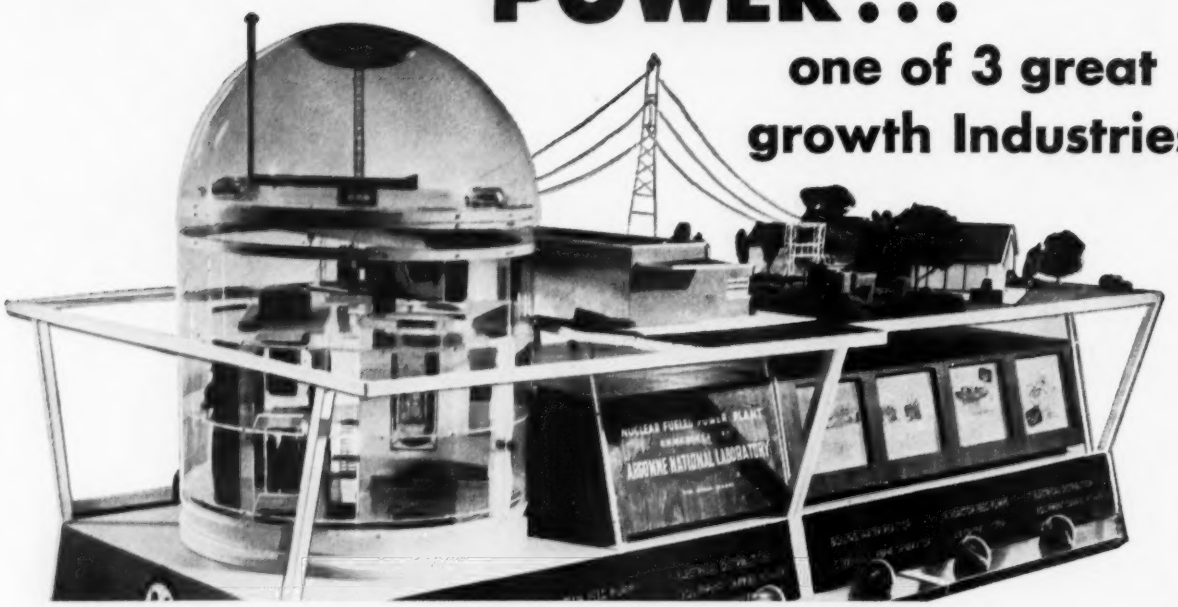

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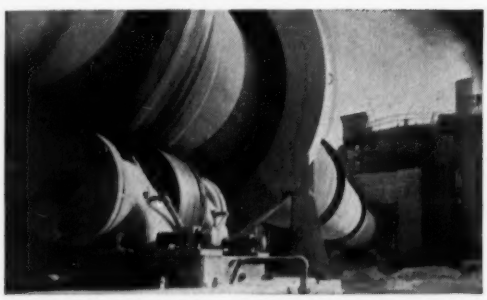
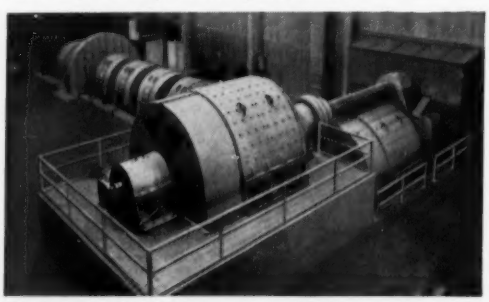
In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.



CONSTRUCTION demands the vast tonnages of cement produced with Allis-Chalmers rotary kilns and other processing machinery.



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DOUG MERKLE, C.E. '57

Activities is the word that best describes Doug Merkle. Doug has been a lacrosse player since his freshman year and last year was on the starting varsity defense line up. During his second and third years he was also a tackle on the 150 lb. football squad. Last year he coached, due to an operation, but this season Doug will be back pounding the line.

Doug has also kept busy with activities beside sports. In his junior year, Doug was corresponding secretary for Red Key, junior men's honorary, and in his senior year was president of A.S.C.E. and secretary of Sphinx Head, senior men's honorary. Doug is a member of Rod and Bob, civil engineering social honorary; Chi Epsilon, civil engineering scholastic honorary; Arnold Air Society, and Scabbard and Blade, both national military honoraries. Last year Doug was vice president and rushing chairman for Psi Upsilon fraternity. Despite this host of memberships and offices, Doug was Engineers' Day chairman for the C.E. school last spring.

Originally Doug planned to be an architect, but after one term he decided that there was a field to which his talents could be more successfully applied—civil engineering. It was necessary for Doug to spend two summers at Cornell in order to make up the credits lacked and to catch up with the rest of his class. However, since then Doug has led his class and now, despite his many activities, has a cumulative average of 89.5. During his third summer, Doug worked for a land surveyor in his home town, Darien, Connecticut, and last summer was spent at Ethan Allen Air Force Base in Vermont with his ROTC unit.

Doug is a permanent dorm counselor this fall and was a frosh camp counselor last fall. Being a good student, Doug has some interesting opinions of the type of education he feels a student should acquire. He does not think liberal and technical education should coincide. There is plenty of time to broaden one's self after graduation, and valuable time should not be subtracted from technical study. Doug firmly believes that anyone who thoroughly desires to learn art or literature after graduation may easily do so and thereby avoid encroaching upon the meager five years set aside for one to learn his life's profession. It is necessary, of course, continues Doug, to realize the importance of the liberal side of education and to obtain it at the right time.

"The mark of a truly educated man is both the desire and the ability to continue his education by personal study, beyond organized classroom lectures."

ROGER BALDWIN, MET.E. '57

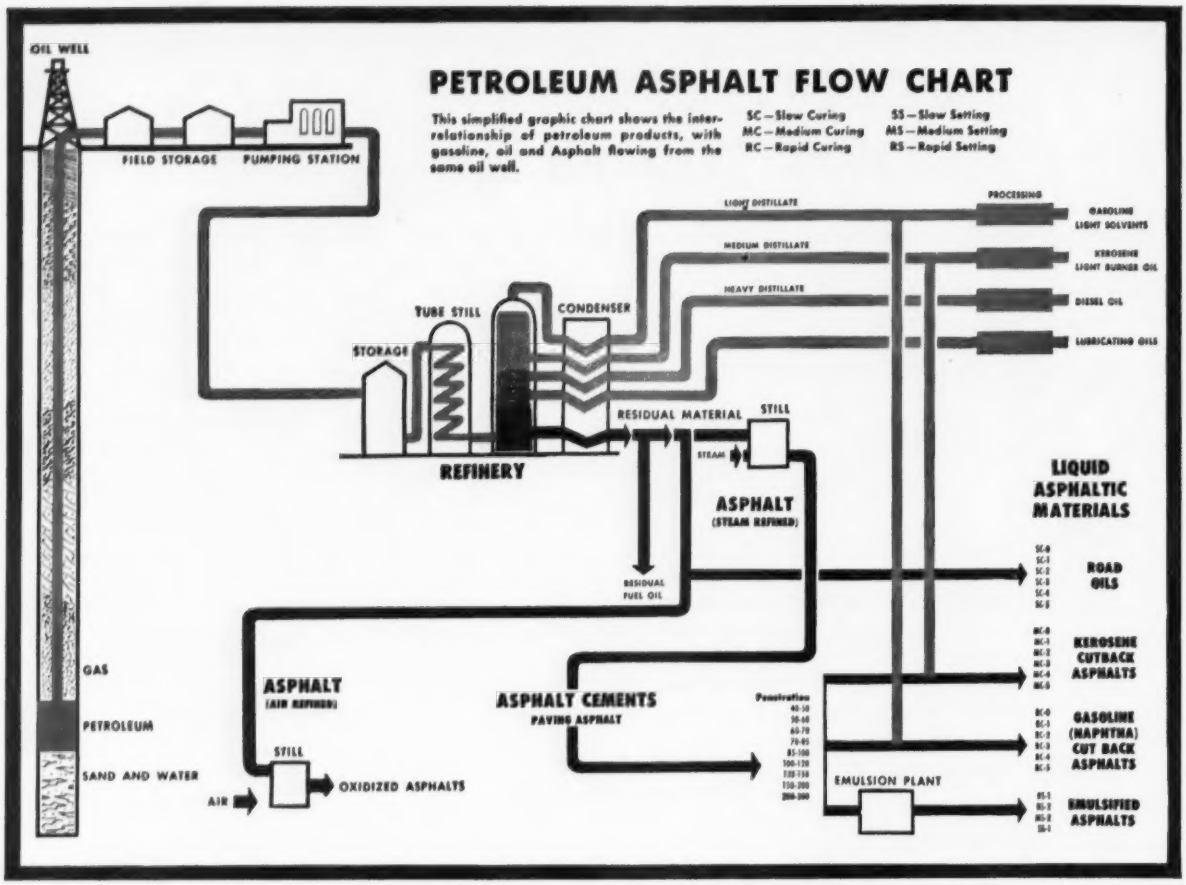
Roger Baldwin, a fifth year student in metallurgical engineering at Cornell, is especially interested in student government. Roger is serving on the Engineering Student Council as vice president, and, in turn, is the Engineering Student Council's representative to the Student Council. When asked why he devotes so much of his time to the Engineering Council and related activities, Roger replies that he feels the Council is one of the most important representative groups on campus. In Roger's opinion, through the Council, interest in engineering can be aroused among precollege students. This interest is vital in fulfilling the need of engineers in industry.

Roger came to Cornell in 1952, the holder of a Navy Scholarship and a New York State Scholarship. He enrolled in the Chemical Engineering School but transferred to the related field of Metallurgical Engineering after two years.

Roger was chosen battalion commander in Navy ROTC and is vice president of Scabbard and Blade, national military honor society. Roger has been on three summer cruises as part of his ROTC training. These cruises have been to points all over the world. Although these cruises have cost Roger the chance for some valuable summer training in industry, he feels they have been very worthwhile. This past summer he worked as a research assistant for a forge and tool company in his home town, Utica, New York.

This past spring Roger served as Engineers' Day publicity chairman. He was able to secure radio and television coverage as well as considerable newspaper coverage. Roger was also responsible for the designing and printing of posters. Roger's experience as editor of his high school newspaper was valuable background for this job. Roger has still another important position in engineering activities—president of Pros Ops—chemical engineering honorary.

Roger's plans for the future are rather well-defined. He will spend three years in the Navy after graduation and will then go into research and development in the field of metallurgy. His particular specialty will be finding new uses for new metals.



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Asphalt is a natural constituent of most crude petroleums. From them, it is separated by various distillation processes that also yield gasoline, lubricating oil and other refinery products. ***Asphalt is a petroleum product and is not to be confused with tar, a black substance commonly derived from the destructive distillation of coal.***

The chart shows grades of Asphalt produced by distillation, blending and oxidation. These range from watery liquids to hard, brittle solids.

The semi-solid form, known as Asphalt cement, is the basic paving material. It is used in hot-mix Asphaltic pavements for roads, airfields, sidewalks, parking areas, dam facings, swimming pools, industrial floors and other structures that require paving.

It's the basis for membrane linings of irrigation canals and reservoirs, protective coating on pipe lines, and structural waterproofing. In fact, Asphalt cements are "tailor-made" for literally thousands of applications, including such every-day items as tires, battery cases, roofings, paints, wall boards, electrical insulating tape and the like.

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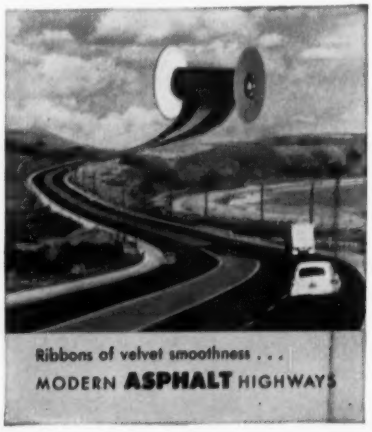
The engineering advances that Asphalt makes practical warrant your study of the art and science of using this durable, economical material.



THE ASPHALT INSTITUTE, Asphalt Institute Building, College Park, Maryland

(Continued from page 19)

striking the driver's chest with a great force. For most other cars, a chest guard or special rubber pad has been developed to be put over the steering post. Padding of the dashboard and sun visor is a development that will cut down injuries to the head. With the correct type of padding, the force of the impact in a crash will be absorbed by spreading the area of contact over a larger part of the head.

Another new safety feature is the seat belt similar to the type used in airplanes. Reports by police in Indiana show that in a ninety-day study with 130 fatal automobile accidents and 153 persons killed, 69% would have lived had they used seat belts, and 12% might have survived. The function of the seat belt is to hold occupants in their seats so they will decelerate with the vehicle in a crash stop instead of being hurtled forward into the windshield or instrument panel or being run down by oncoming traffic. The ideal belt includes a lap belt and a shoulder harness, but feeling that there is a limit to what the public will accept, researchers have decided to just recommend a good lap belt. While it will not always prevent head contact with the dashboard, it will restrain more than half of the body's weight. The seat belt follows the third and fourth principles of packaging. It prevents the motorist from striking the walls of the container and it holds the body by one of its stronger parts, the pelvic bone.

The basic standard requirements for seat belts as set up by the Cornell Aeronautical Laboratory are fairly widely accepted throughout the industry. There should be a separate belt for each occupant rather than a car wide seat. This allows better side support and prevents two people from being thrown against each other. The belt should have a minimum loop load strength of 3000 pounds or a tensile load strength of 1500 pounds. When it is new, the tensile load strength should be about 2250 pounds because the belt will get weaker with age. These figures were arrived at by the fact that the human compartment of an automobile begins to collapse when the force in a head-on collision involves a deceleration of more than fifteen "G's". One "G" of deceleration of a body needs a force equal to the body's weight to hold it in position. Therefore a 200 pound man would need a 3000 pound pull to hold him in position in his seat when the car decelerates at fifteen "G's". The belt itself should be about two inches wide. If it is too narrow, there is a high load concentration and it will cut the skin. If it is too wide, there is excessive folding. The belt can be made of any material meeting the basic requirements. A one-eighth inch thick, tight, cotton webbing, the same as is used in airplanes, has been found satisfactory. It offers good slip-resistance to the buckle. The buckle and webbing when closed should test together with the minimum tensile load strength of 1500 pounds. The buckle should have only one way to be threaded, so it will always be threaded correctly. It should also have a quick easy release which can be accomplished with one hand. The buckle should be satisfactory if a 200 pound person can open it with a forty-five pound pull after it has been subjected to a 3000 pound loop load.

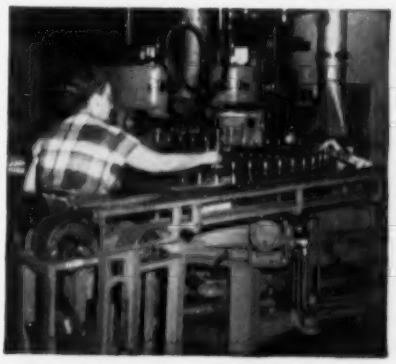
For installation,the ultimate anchorage of every belt must be the frame of the car. The belt should be in position over the lap at an angle of thirty to sixty degrees and the ends of the belt, from the motorist to the anchorage point, should be parallel to the side of the car. The full load of all the belts, simultaneously applied, should be carried eventually to the frame of the car without causing permanent deformation to any intermediate load carrying member of the system. The belt should never be secured solely to the seat of the car. Safety belts are useful in making long trips less tiring by giving more support to the body and in the event of a disturbing jolt, they are very effective for steadying the driver in position behind the wheel where he can continue to control the car. The belts can be installed in almost any car on the road today at a moderate cost.

Engineers hope eventually that they can come up with a vehicle

(Continued on page 56)

An idea to build your future

How to cut changeover time



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Denison hydraulic Multipress equipped with index table.

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GRADUATE RESIDENCE CENTER ESTABLISHED AT LOS ALAMOS

Los Alamos Scientific Laboratory has completed arrangements with the University of New Mexico for the establishment of a Graduate Residence Center at Los Alamos. This program will provide the opportunity for employees and residents to meet all of the requirements for the master's degree in the physical sciences and engineering (including Nuclear Engineering) by attendance at evening classes. Some of these courses are taught by Laboratory personnel outstanding in their fields.

In addition, there are extensive course offerings in the undergraduate and technician training fields for those wishing to pursue academic training related to their jobs or for their own development.

Complete information about career opportunities and the academic training programs can be had by writing,

Director of Scientific Personnel
Division 561

that is able to take a severe head-on accident without resulting in injury to the occupants. "This will be strictly a paper study and for the moment we have no plans to construct a 'crashproof' car," said Edward R. Dye, head of the Cornell Aeronautical Laboratory's Industrial Division and an authority in auto crash safety work. "We will try to incorporate findings of the Laboratory's research in the last three years into the design of a full scale auto body which will better protect auto occupants."

"This 'car of tomorrow' is not the type of auto that will be rushed into production," Dye said. "What we hope to do is to interest the public and auto manufacturers in as many of the safety innovations as are possible."

Dye's recommendations include the elimination of the steering wheel in favor of levers on either side of the driver and a dash panel that pulls out and "wraps around" the driver. Added reinforcement to prevent the collapse of the midsection of the car during a roll over and relocation of the instruments to the level of the car's hood would also provide additional security, he believes.

Visibility studies may result in placing the driver in a spot where he can see and control the car better. Side bumpers to increase structural stiffness, the facing of all seats to the rear, the relocation of instruments closer to the level of the car's hood, and installation of padding in areas where the head might come in contact with the automobile in a crash are other considerations.

"All of these ideas are of course preliminary and our final decisions will depend upon our design study," Dye said. "The driving public, if it wants safer cars, must eventually reverse its present philosophy of spaciousness in the auto to one of compactness. Proper packaging will greatly reduce the possibility of injury and death in an auto crash."

He emphasized that the design study should not raise the hopes of anyone driving today since final development is years away. "For today's driver, I'd recommend a seat belt and, by the way, a seat belt that meets minimum strength requirements."

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BRAINTEASERS

Another term of school has now started. It won't be long before the "prelims," as inevitable as death and taxes, will be coming our way. We had better start oiling up the mental machinery as soon as possible.

Here are some short puzzles, designed to give your thinking machine a little exercise. Why not sit down right now and try to work them out? You will be able to read the answers in next month's issue, if the editors can figure out the answers themselves.

Here is an easy one to start off. The answer is printed below, so that you can check yourself before plunging into the real toughies. But don't peek!

How would you measure the height of the Libe Tower with a barometer and a stopwatch?

Got that one? Now here are some more challenging problems:

Problem 1. Four men, Joe, Tom, Jim, and Dick, and their wives Anne, Mary, Barbara, and Jane, went to an auction. While there, each man and each woman bought certain objects. The average price that each person paid for the objects that he or she purchased was equal to the number of objects that that person bought. Each wife spent $165 more than her husband, Jim spent $1 more than Anne, Barbara spent $27 more than Tom, and Dick spent $7 more than Jane. What was the name of each man's wife?

Problem 2. Find the value of the infinite continued fraction:

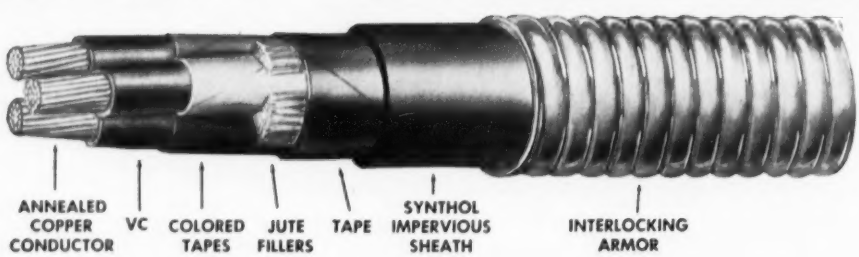
$$\cfrac{1}{7+\cfrac{1}{7+\cfrac{1}{7+\cfrac{1}{7+\cfrac{1}{7+\cdots}}}}}$$

Problem 3. Recently an engineer went into a candy store to buy a dime's worth of jellybeans. While making the purchase he clumsily knocked over the whole jar, spilling 573 jellybeans on the floor. The angry proprietor demanded payment; but the engineer, being more agile with his brain than he had been with his hands, challenged the proprietor to a contest.

Each would take turns picking up jellybeans, and anywhere from one to twenty-five beans could be picked up each turn. The person

(Continued on page 59)

CRESCENT ARMORED CABLE



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Unionization

(Continued from page 46)

unions will ever recruit significant numbers of professionals, due to the professionals' deep-rooted distrust of the aims of labor unions and their reluctance to be identified with other groups of workers.

To a large extent the fault lies with management in failing to recognize and meet the needs of its engineers. It is important for management to provide for the economic and professional status which the engineer feels he deserves by nature of his work. Most engineers, even those dissatisfied with their situation, consider that they are or will be a part of management. Nevertheless, if the engineer cannot make himself heard individually in matters of wages, hours, or conditions of work, he will seek a group to do this for him. His professional society has been unwilling to do so and thus, the professional union follows. The "sounding board" type of organization is probably a better way of airing problems between employers and employees, but they are all too few. There is also some question as to their legality since they may be construed to be "employer-dominated labor organizations," illegal under the Taft-Hartley Act.

In a study of the sociological aspects of professional unionism [3], B. Goldstein concludes that the professional union may eventually become the central core of a new engineering federation which would combine the elements of the professional societies with the economic interests of the labor unions. Alternately, they may be drawn into the trade unions. The former is much to be preferred.

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Brainteasers

(Continued from page 58)

forced to pick up the last bean would lose the argument. The engineer courteously allowed the proprietor to take the first turn. The proprietor did, and it was his downfall. How did the engineer force the proprietor to take the last bean?

Problem 4. There was recently a sale of various articles of ladies' apparel on the second floor of a downtown department store. A young woman and her grandmother were rushing to get to the sale before the best bargains were all gone. They reached the foot of the escalator going from the first floor to the second floor at the same time and stepped on the first step together. Since they were both in a hurry to get to the sale, they did not stand still and ride the escalator up, but walked up, both at a constant rate, until they reached the top. The young lady forgot that her grandmother could not keep up with her, and walked as fast as she could. The older woman was only able to take one step for every three that her younger companion took. Of course, when the young woman reached the top, she had to wait for her grandmother, so she didn't gain anything by her rushing. The granddaughter took 36 steps, her grandmother took 24 steps. How many steps were in sight at one time on the moving staircase?

Now here is the solution to the practice problem.

To measure the height of the Libe Tower, climb to the top, drop the barometer, and time its fall with the stopwatch. Then use the familiar formula $\frac{1}{2}gt^2$. Aren't you ashamed of yourself for not thinking of that?

BIG DEAL

She- "Well, after all, where we live seems to me about as important as where you work. We should think ahead four or five years. Where will we be? What kind of life will we have?"

He- "I'll buy that. We should take that job with Public Service and live in New Jersey."

Good thinking, man! Public Service Electric and Gas Company — one of the country's important utilities — has as its service area a section of New Jersey replete with all the elements of good living.

With New York at one end and Philadelphia at the other, the area abounds in cultural advantages. Educational advantages are superb. Recreational facilities — seashore and mountains — are close by. Great research organizations and industrial enterprises bring into the area outstanding men and women who will be your neighbors.

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College News

NEW CHEM.E. PROFESSOR

Dr. Robert York of St. Louis, Mo., has been appointed the first Socony Mobil Professor of Chemical Engineering, Cornell University announced today (June 13).

The new chair, made possible by a five-year grant from Socony Mobil Oil Company, Inc., and intended primarily for undergraduate instruction, is believed to be the first of its kind to be established by an American university.

To fill the position Cornell sought a man of established reputation who is nationally recognized in his field and who has had extensive experience in private industry.

Dr. York has been assistant director of the General Development Department of Monsanto Chemical Company in St. Louis since 1953.

He holds B.S. and M.S. degrees in mechanical engineering from the University of Tennessee and in 1938 was awarded the degree of Sc.D. in chemical engineering by Massachusetts Institute of Technology.

A member of the engineering faculty of Carnegie Institute of Technology from 1938 to 1947, Dr. York first worked for Monsanto while on leave from the Institute during the war. He rejoined the company in 1947, becoming assistant director of the General Development Department three years ago.

Dr. York is a registered professional engineer in Pennsylvania and Missouri. He is a member of the American Chemical Society and the American Institute of Chemical Engineers, as well as Tau Beta Pi, honorary engineering fraternity, Phi Kappa Phi, honorary scholastic fraternity, and Sigma Xi, honorary research society.

E-DAY WINNER

The award for the best exhibit on Engineers' Day, May 4, 1956, went this year to the E.E.'s. The highlight of their exhibit was a lecture-demonstration on "Electronics, Music, and Sound," presented by Ron Yeaple, Russ Gould, and Jim Vaughan. The program covered

Dr. Robert York

such topics as electronic musical instruments, electronic recorder, and the evolution of the phonograph.

The exhibit of power systems and machines gave visitors a chance to show how powerful they were by turning a hand crank that supplied power to a d-c generator. Also shown were street lighting systems and a cut-away shell of a motor.

The communications display featured a voice phase delay apparatus with which the operator could hear his own voice after a certain delay time had elapsed, a cathode-ray oscilloscope on which you could "see" your voice, transmission of music over a light beam, and an alligator that snapped at anyone coming too near.

Some of the functions of the vacuum tube laboratory were illustrated by such exhibits as electroplating of electrodes, microphonic testing of vacuum tubes, a high current electron gun, automatic sealing of miniature vacuum tubes, and electric field plotting by means of an electrolytic tank.

The servomechanisms lab had on display a B-29 gun turret, a radar antenna that demonstrated on a small scale how large mechanisms can be controlled by the manual actions of an operator, an electrolytic plotting tank used to automatically trace the equipotential lines of an electric field, and a simple positional control system.

Several electronic devices commonly used in industrial situations were demonstrated. The well-known Geiger counter and electric eye were on display, as well as welding controls for the resistance-welding method of joining metals, and a Precipitron, or electrostatic air cleaner, which removed smoke and dust particles from the air. A Navy radar set was set up to sweep the skies over West Hill up to a range of 100 miles.

A wide variety of light sources were shown, and many interesting effects with colors could be seen. Several types of computers, calculators, and a fluid network analyzer were set up. The Amateur Radio Club set up a complete sending and receiving unit, and also operated a teletype network between Barton and Phillips Hall which was used to relay radiograms from guests to their families anywhere in the country.

NEW OFFICER AT AERO LAB

Alexander H. Flax was elected Vice President for Technical Operations at the annual meeting of the Board of Directors of Cornell Aeronautical Laboratory, Inc., held in June.

Mr. Flax, who is Assistant Director-Technical at the Laboratory, fills the vacancy created by the recent resignation of Will M. Duke. In his new post, the 35-year-old Mr. Flax will be responsible primarily for the planning and coordination of the over-all technical program at the research laboratory, located in Buffalo, N. Y.

He received his bachelor of aeronautical engineering degree from N.Y.U. in 1940 and has done graduate study at both Cornell University and the University of Buffalo. Mr. Flax has previous experience with the Curtiss-Wright Corporation as well as Piasecki Helicopter Corporation.

In his new role, Mr. Flax reported to the Board of Directors on the Laboratory's military research,

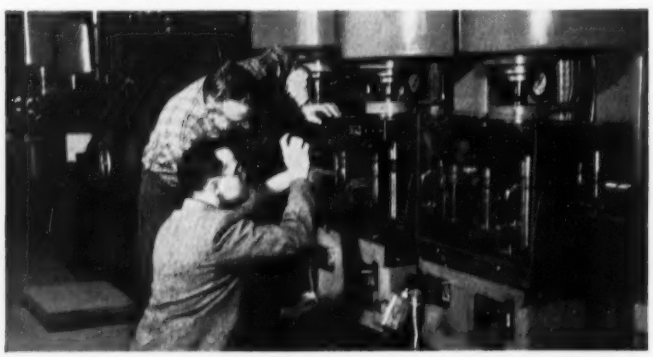
(Continued on page 63)

Meet Dick Foster

Western Electric development engineer

Dick Foster joined Western Electric, *the manufacturing and supply unit of the Bell System, in February 1952, shortly after earning his B. S. in mechanical engineering at the University of Illinois. As a development engineer on a new automation process Dick first worked at the Hawthorne Works in Chicago. Later, he moved to the Montgomery plant at Aurora, Illinois where he is pictured above driving into the parking area.*

Dick's day may begin *in one of several ways: an informal office chat with his boss, a department "brain session" to tackle a particularly tough engineering problem (above); working with skilled machine builders in the mechanical development laboratory; or "on the line" (below) where he checks performance and quality and looks for new ways to do things.*



Here Dick and a set-up man check over *the automatic production line used to manufacture a wire spring relay part for complex telephone switching equipment. This automatic line carries a component of the relay on a reciprocating conveyor through as many as nine different and very precise operations—such as percussive welding in which small block contacts of palladium are attached to the tips of wires to within a tolerance of ± .002".*

Examining the plastic molded "comb" *components of the wire spring relay Dick recalls his early work when he was involved in working-up forming and coining tools for the pilot model of the automation line for fabrication of wire spring sub-assemblies for relays. At present he is associated with the expansion of these automation lines at the Montgomery Plant.*

Dick finds time *for many Western Electric employee activities. Here he is scoring up a spare while tuning up for the engineers' bowling league. He is active also in the golf club, camera club, and a professional engineering society. Dick, an Army veteran, keeps bachelor quarters in suburban Chicago where he is able to enjoy the outdoor life as well as the advantages of the city.*

Western Electric offers a variety of interesting and important career opportunities for engineers in all fields of specialization in both our day-to-day job as the manufacturing and supply unit of the Bell System and in our Armed Forces job.

If you'd like to know more about us, we'll be glad to send you a copy of "Your Opportunity at Western Electric" which outlines the Company operations and specific job opportunities in detail. Write: College Relations Department, Room 1030, Western Electric Co., 195 Broadway, New York 7, N. Y.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; Haverhill and Lawrence, Mass.; Lincoln, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 16 cities. Company headquarters, 195 Broadway, New York City.

College News

(Continued from page 61)

which is the bulk of the organization's scientific program. In his review he revealed for the first time that the Laboratory is developing a new and significant device in the field of high temperature testing of ballistic missiles.

He discussed the status of the Laboratory's current missile programs and also revealed progress in the development of a highly advanced military computer, used as an aid for controlling interceptor aircraft.

Mr. Flax also reviewed the successful operation of the C.A.L. wind tunnel, which has come to be the busiest tunnel in the nation, and discussed some of the Laboratory's future plans, including nuclear engineering.

Mr. Ira G. Ross, Laboratory Director and Executive Vice President, discussed the Laboratory's program in industrial research. He cited the Laboratory's continuing work for General Motors on automobile handling, an outgrowth of studies in aircraft stability, as an excellent example. He also pointed to C.A.L.'s current efforts in tire testing for several automobile tire manufacturers.

In this program of tire evaluation, Mr. Ross reported, Cornell is employing a unique device, valued at $175,000, which was developed for the Air Force to test aircraft tires. It is the only such device of its kind and makes measurements by means similar to those used in the Laboratory's wind tunnel testing.

The Laboratory reported that its volume of research for the year ending June 30, 1956 was $14 million. A volume of $14,600,000 was forecast for the coming year by Henry K. Moffitt, Vice President for Business.

In addition to the new election of Mr. Flax as Vice President, all other corporate officers were re-elected, including Dr. T. P. Wright as President and Chairman of the Board.

Cornell Aeronautical Laboratory is a non-profit corporation and operates in Buffalo, N. Y., as a self-sustaining part of Cornell University. The Laboratory has a staff of 1200 people and its efforts are purely in the research field.

GUGGENHEIM FELLOWSHIPS

SEVEN FACULTY MEMBERS and nine other Cornellians are among the 275 recipients of new fellowships from the John Simon Guggenheim Memorial Foundation. The grants, totalling $1,100,000 this year, are made to scholars carrying on research in all fields of knowledge and to persons engaged in creative activities in all the arts.

(Continued on page 65)

ANNOUNCEMENT

We would like to tell all out-of-town readers that we carry the finest drawing and engineering equipment manufactured today, and we welcome your written inquiries. Our suppliers include:

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Chas. Bruning Co., Inc.

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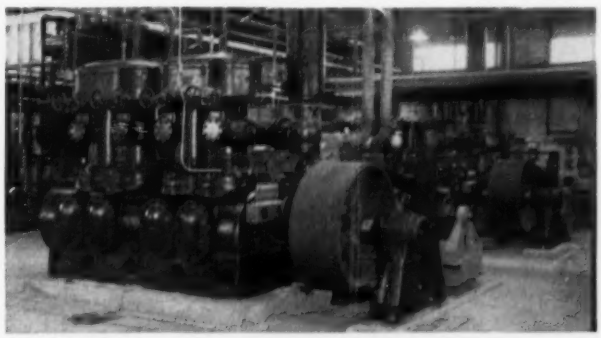

FRICK

Compressors Make Dry Ice With New Economy

The Colorado CO_2 Corp. produces up to 50 tons of solid carbon dioxide daily in its $2½-million plant near Las Animas, Colo.

The gas, obtained from wells 5 miles away, is condensed, subcooled, and solidified at 109 degrees below zero F. with a new Frick-engineered cycle operating at very economical pressures.

Practically all the mechanical equipment in the plant was furnished and installed by Frick Company. Another example of the COMPLETE engineering service that is yours when you purchase Frick air conditioning, ice making, quick freezing or other refrigerating equipment.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, offers a career in a growing industry.

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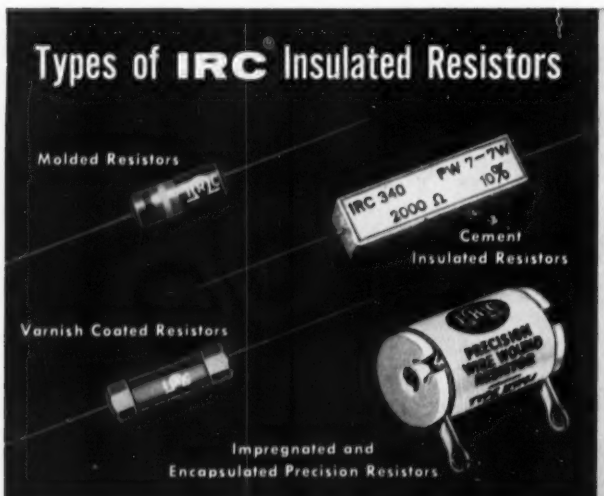
Specially-compounded coatings and housings enable IRC resistors to withstand a higher degree of impact, shock and vibration than any other resistors of their type.

The skillful combination of protective coatings and resistive elements assures superior moisture resistance and heat dissipation, as well as protection from severe humidity or temperature conditions.

Exactly how important are resistor insulations?

In a sense, a resistor is simply a mechanical device for packaging ohms. So it is easy to see why the materials making up the mechanical package greatly determine resistor performance. In fact, insulation is so important that more than one-third of the 200 technicians at IRC are engaged in developing custom-tailored insulating coatings and housings for IRC resistors. That's why every IRC resistor is better protected from damage and ambient conditions than any other of its type. And at no extra cost.



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College News

(Continued from page 63)

One of those to receive a fellowship, Professor George Winter, Ph.D. '40, Structural Engineering, left June 1 for ten or fifteen months of studying structural engineering in Europe. He will also lecture at the Universities of Glasgow and Cambridge.

MET.E. CONFERENCE

METALLURGICAL Engineering Division of the School of Chemical & Metallurgical Engineering held a conference in Olin Hall, May 9, on "Training of Metallurgical Engineers." Guests from some twenty organizations interested in metallurgy as producers, fabricators, or consumers joined with Faculty members to discuss problems related to effective preparation of metallurgical engineers for professional work. Vernon H. Schnee '19, executive director of the materials advisory board under the National Academy of Sciences and a member of the Engineering College Council, moderated the discussion. A dinner honoring Francis N. Bard '04 of Chicago, Ill., donor of the Bard Professorship in Metallurgical Engineering, was held at Taughannock Farms Inn.

WINNERS OF ESSAY CONTEST

Four students in Cornell's College of Engineering won prizes in an annual student paper contest sponsored by the Ithaca Section of the American Institute of Electrical Engineers.

John L. Haynes, EE '56, winner of the first prize of $40, competed in the AIEE Northeastern District student paper contest in Rochester on May 4. His paper was on "The Realization of Infinity."

Lawrence L. Phillips, EE '57, whose paper was on "The Problem of the National Shortage of Engineers," won second prize of $30.

The $20 third prize winner, Hugh Paul Janes, EP '56, competed in a contest in New Haven, Conn., sponsored by the Connecticut Valley section of the Institute of Radio Engineers. His discussed "The Determination of Atmospheric Refraction of Radio Waves by Interferometer Techniques."

A paper on "A Digital Differential Analyzer" won the fourth prize of $10 for Irwin M. Jacobs, EE '56.

ACS OFFICERS

The Cornell section of the American Chemical Society has elected Prof. Herbert F. Wiegandt of the School of Chemical and Metallurgical Engineering as chairman to succeed Prof. Harold A. Scheraga of the Department of Chemistry.

Prof. J. L. Hoard, chemistry, was named vice chairman. Prof. J. E. Dawson, agronomy, Prof. R. K. Finn, chemical engineering and Prof. A. W. Laubengayer, chem-

(Continued on page 67)

LAVA

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GRAPHITE CRUCIBLES
HIGH-TEMPERATURE CEMENTS
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LEADER IN LUBRICATION FOR NEARLY A CENTURY

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Mobil Overseas Oil Company and Mobil Producing Company

(Continued from page 65)

istry, were elected to the executive committee.

Prof. Paul J. Flory and Prof. F. A. Long, chemistry, will become section councilor and alternate councilor, respectively, on January 1, 1957, for three-year terms of office.

PRESENTATION OF PORTRAITS

A Baltimore artist gave Cornell one of his most prized paintings, a portrait of his friend, the late Vladimir Karapetoff, who taught electrical engineering at the university.

Stanislav Rembski, the artist, presented the portrait after a reunion breakfast of electrical engineering alumni on June 9 in Phillips Hall. H. Alfred Stalfort '34, vice president of Consolidated Engineering Company in Baltimore, also participated.

Karapetoff, one of Cornell's best-loved professors, was a musician, poet, composer and inventor as well as an engineer. Even after he became blind in 1943, he continued an active life as a lecturer, pianist and consulting engineer. He died in 1948 in New York City.

His friendship with Rembski began in 1929. The portrait was painted in 1931, when Rembski had come to visit and to learn about a five-stringed cello the professor had invented.

Professor Karapetoff was born in 1876 in Petrograd, Russia, and came to this country in 1902. He joined the Cornell faculty in 1904 and became professor emeritus in 1939.

A portrait of Ellis L. Phillips, who gave Cornell its electrical engineering building, was unveiled June 10 in the Phillips Hall lounge.

Mr. and Mrs. Phillips, of Plandome, L. I., were present. Their granddaughter, Christine Richards, a graduating senior, unveiled the portrait, and President Deane W. Malott spoke.

Mr. Phillips is a member of the Cornell class of 1895 and a founder of the Long Island Lighting Company. He presented Phillips Hall a year ago during his 60-year reunion.

BULLOCK WINS PHOTOGRAMMETRIC AWARD

Paul Bullock, a student of the School of Civil Engineering has won second prize in the Bausch & Lomb Photogrammetric Awards.

Bullock received his citation and cash prize at the annual convention of the American Society of Photogrammetry held in Washington, D. C. The awards are presented by the Rochester, N. Y., optical firm for the most outstanding papers on photogrammetry—the science of making maps from aerial photographs.

A native of Salisbury Center, N.Y., Bullock is a veteran of the Korean War. He is 24.

Bullock's prize winning paper was entitled "Atmospheric Haze in Aerial Photography" and dealt with the problem of taking photographs through the haze that frequently fills the air, especially near large cities.

After graduation he plans to go into general contracting, specializing in map making.

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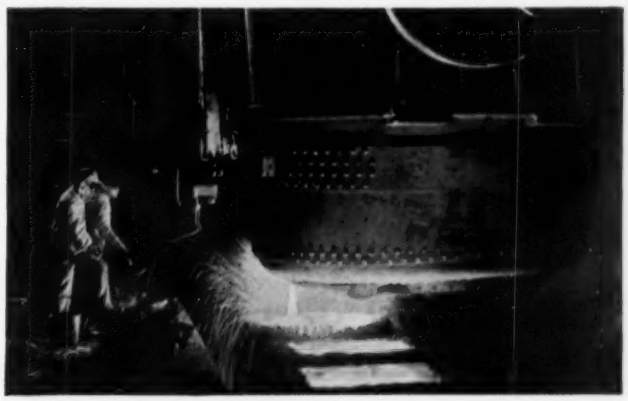

Abundant, durable, versatile and comparatively cheap, steel in its many carbon, alloy and stainless forms is the most useful of all the metals at man's disposal. Unknown in nature, steel had to be created by man's ingenuity, from iron ore and other available natural materials.

Today, an estimated 1½ billion tons of steel are in use in this country. With a capacity of about 125 million net tons a year, American steel mills can produce close to half the world's annual total. Used for everything from buildings to pins, the total applications of steel are almost countless; *it is virtually impossible to find a product that does not depend on steel for its production or distribution, or both.*

Steel's steady growth reflects the importance of its contributions to America's greatness. Much credit must go to the industry itself, which did not hesitate to execute a bold post-war capacity expansion program of more than 28 million net tons at a cost of nearly 6 billion dollars. The steel companies are carrying on an intensive two-fold program to develop new sources of ore. While spending hundreds of millions of dollars to open fields in Labrador and elsewhere, they are also investing heavily in engineering developments that will make it possible to use domestic low-grade ores such as taconite.

Interwoven with the history and progress of steel is the development of steam generation for power, processing and heat. B&W, through the applications of steam, has long been a partner in the vital steel industry—has brought to it boiler building experience covering almost a century, built on the results of a continuing, intensive program of research and engineering development. In steel as in all industry, improvements in steam generation will continue to make genuine contributions toward still better products and services. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N. Y.

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IF YOU are a **MECHANICAL** or **ELECTRONICS ENGINEER,** you may be involved in a project in any one of these fields, as a basic member of the task force assigned each research problem. Your major contribution will be to design and test the necessary equipment, which calls for skill at improvising and the requisite imaginativeness to solve a broad scope of consistently unfamiliar and novel problems.

If you are a **PHYSICIST** or **MATHEMATICIAN** you may be involved in such fields of theoretical and experimental physics as weapons design, nuclear rockets, nuclear emulsions, scientific photography (including work in the new field of shock hydro-dynamics), reaction history, nuclear physics, critical assembly, high current linear accelerator research, and the controlled release of thermo-nuclear energy.

If you are a **CHEMIST** or **CHEMICAL ENGINEER,** you will work on investigations in radiochemistry, physical and inorganic chemistry and analytical chemistry. The chemical engineer is particularly concerned with the problems of nuclear rocket propulsion, weapons and reactors.

In addition, you will be encouraged to explore fundamental problems of your own choosing and to publish your findings in the open literature.

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See the Sandia Corporation representative with the Bell Telephone Recruiting Team

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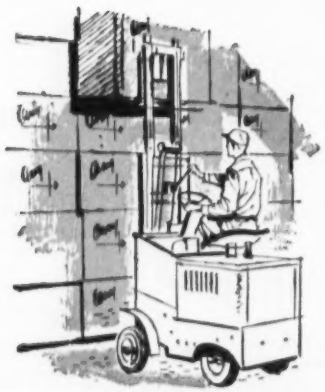

TODAY: Leading lift truck manufacturers rely on New Departure "sealed and lubricated-for-life" ball bearings to carry rugged loads without "downtime" or adjustments for wear.

Here's tomorrow's "look" in warehousing! **Electronically, orders are received, checked against inventory, assembled, packed, wrapped, labeled, and whisked to shipping—untouched by human hands!**

When this futuristic "stock-chaser" takes shape, its intricate moving parts will turn on New Departure ball bearings . . . preferred throughout industry for their accuracy, dependability, and service-free performance.

As every engineer knows, New Departure can be relied upon to look to the future while serving dependably today.

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Another example of how the Company's seven producing divisions are allied to serve you better.

TRADEMARK PRODUCTS INCLUDE:

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61 BROADWAY, NEW YORK 6, N. Y.

STRESS and STRAIN...

Two engineering students were taking calculus for the first time and while waiting for the instructor to arrive, they took a quick perusal through the book. One of them came across the integral tables in the back of the book.

"Tell me," he asked his friend, "can you read that?"

"No," replied his friend, "but if I had my flute with me I could play it."

* * *

"It's quite simple," explained one of the seniors in EE, "to hook up an electric power circuit. We merely fasten leads to the terminals and pull the switch. If the motor runs, we take our readings. If it smokes, we sneak it back and get another one."

* * *

The only thing worse than being a bachelor is being a bachelor's son.

* * *

The Southern father was introducing his family of boys to a visiting governor.

"Seventeen boys," exclaimed the father, "and all Democrats—except John, the little rascal. He got to readin'."

* * *

The teacher was quizzing the class. "Now, who can tell me who gave us our nice schoolhouse?"

"Harry Truman, teacher."

"That's right, Johnny. Who knows who gave us our beautiful parks?"

"Harry Truman, teacher."

"That's right, Mary. Who gave us the birds and the bees, the flowers and the trees?"

"God did, teacher."

Voice from the back of the room, "Throw that Republican outa here!"

Doris: "I can't marry John, father. He's an atheist and doesn't believe there's a hell."

Father: "Go ahead and marry him, Doris, you'll convince him."

* * *

The fellow and girl charged around a corner and bumped smack into each other. They stepped back, apologized and started up again. But they both dodged in the same direction and bumped once more. Again they started up, bumped and apologized. This time the fellow stepped back, raised his hat and gallantly remarked, "Just once more, cutie, then I really have to go."

* * *

P.E. "Do you know the difference between a politician and a lady?"

E.E. "No . . ."

P.E. "When a politician says yes he means maybe, when he says maybe he means no, and when he says no he is not a politician. When a lady says no, she means maybe, when she says maybe she means yes, and when she says yes she's not a lady."

* * *

A freshman leaned over to his neighbor and asked the meaning of the letters.

"Well, you know what B.S. means, don't you?"

"Sure."

"Then, M.S. means more of the same and Ph.D. means piled higher and deeper."

* * *

I serve one purpose in this school
On which no man can frown.
I quietly sit in every class
And keep the average down.

It was that sleepy time of the afternoon. The prof droned on and on about formulae, constants and figures. An engineer, sitting in the second row, was unable to restrain himself any longer and gave a tremendous yawn. Unfortunately as he stretched out his arm he caught his neighbor squarely under the chin, knocking him to the floor. Horrified, he bent over the prostrate form just in time to hear a murmur. "Hit me again, Sam, I can still hear him."

* * *

A girl was driving in her new car when something went wrong with the engine. The traffic light changed from green to red and back to green and still she couldn't get the car to budge. The traffic cop came up.

"What's the matter, miss?" he inquired. "Ain't we got colors you like?"

* * *

A tramp knocked on the door of an inn known as "George and the Dragon." When the landlady opened the door the tramp asked:

"Could you spare a hungry man a bite to eat?"

"No!" snapped the woman, slamming the door.

The tramp knocked again and slipped his foot in as the woman opened the door. "Could I speak to George?"

* * *

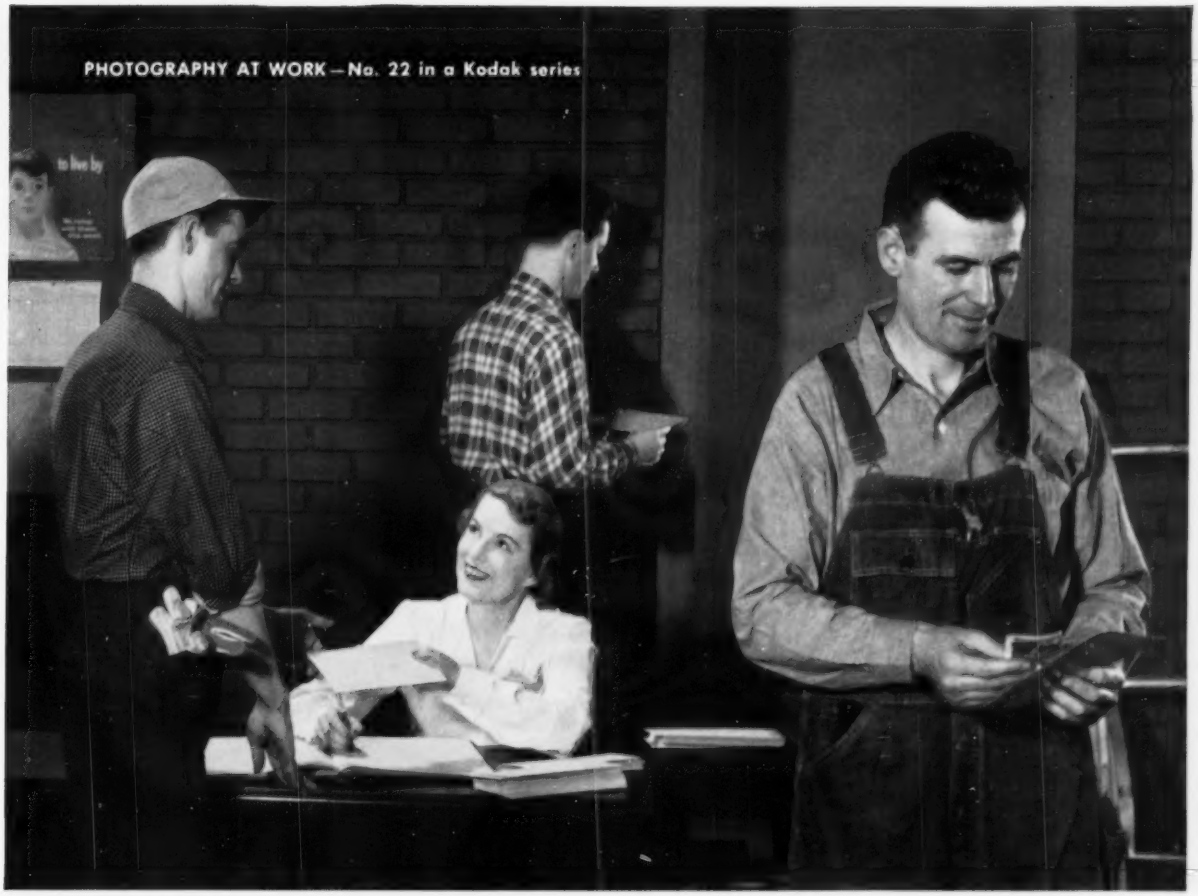
Blue eyes gazed at mine—vexation
Soft hands clasped in mine—
palpitation
Fair hair brushing mine—expectation
Red lips close to mine—temptation
Footsteps—damnation.

* * *

Engineer: "What well developed arms you have!"

Cute Coed: "Yes, I play tennis."

Engineer: "You ride horseback, too, don't you."



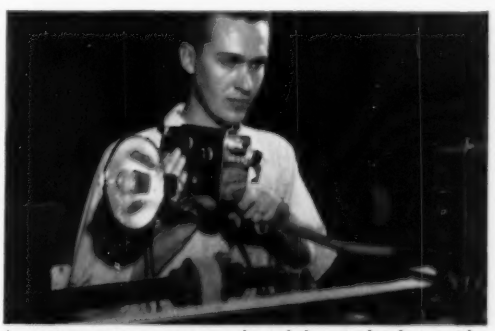
Photography moved in, and...
Out went the Doubts about Payroll Arithmetic

With some 2000 counters on their looms, the Fulton Bag and Cotton Mills faced the task of fast and accurate readings. Camera and film do the job in a fraction of former time and provide a conclusive record.

At Fulton Bag and Cotton Mills, employees are paid according to hand and pick "clocks" on their looms. It used to take 24 man-hours daily to read those meters. And there was always the chance of human error that could not be confirmed or denied at a later date.

So photography was put to work. Now the click of a camera shutter gets an accurate permanent record. No more doubts—no room for suspicion—everyone is happier. And "reading time" has dropped two-thirds. What's more, this has given Fulton a daily loom-by-loom check on the efficiency of its machines.

Building employee morale, checking efficiency, saving time and money are just samples of what photography is doing for business and industry.



A motion picture camera, adapted for single shots with "strobe" flash, snaps thousands of readings on a roll of film.

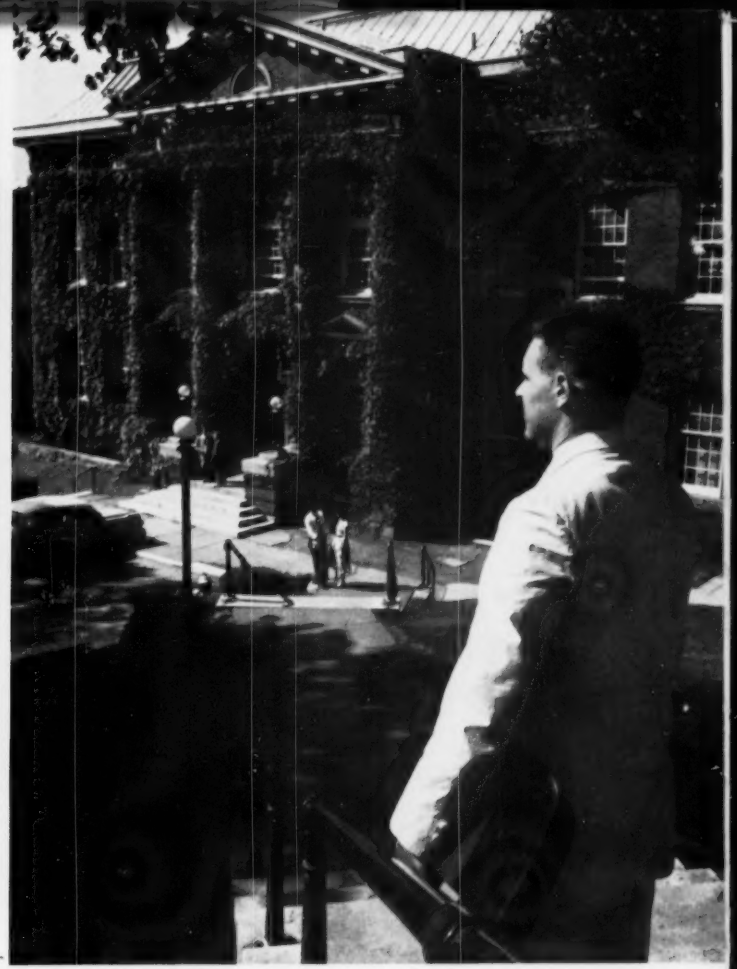
Behind the many photographic products becoming increasingly valuable today and those planned for tomorrow lie challenging opportunities at Kodak in research, design, production, and business.

If you are interested in these interesting opportunities—whether you are a recent graduate or a qualified returning serviceman, write to the Business and Technical Personnel Dept.

Eastman Kodak Company, Rochester 4, N. Y.

Kodak

ATOMIC RESEARCH at General Electric complements Paul Hess' Honors Program Studies.



MASTER'S STUDY at nearby college helps contribute to Hess' professional growth.

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To help outstanding engineers and scientists improve their technical competence in the face of industry's increasingly complex engineering problems, the General Electric Company has inaugurated a new Honors Program for Graduate Study. The Honors Program offers high calibre technical graduates the opportunity to complete the requirements for a Master's Degree in one and one-half years while working part-time on a G-E engineering assignment.

Here is what the program means to you, the technical graduate. If you qualify, you will attend one of several recognized universities located near General Electric plants throughout the nation. Carrying approximately one-half an academic load and doing your thesis work during the summer, you could obtain your Master's Degree in 18 months. General Electric pays for tuition, fees, books and other expenses related to your studies.

During the school term you will work 20 to 26 hours a week on a rewarding engineering assignment. Since your earnings are proportional to hours worked, you can attain up to 75% of a regular annual wage through full-time employment during summer vacations. You are also eligible for all employee benefits.

For more information on General Electric's Honors Program, which has been designed to help outstanding men develop to their fullest capabilities, consult your Placement Director or write W. S. Hill, Engineering Services, General Electric Co., Schenectady, N.Y.

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